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UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF APPEALS AND INTERFERENCES

Appl. No.:	09/929,995	Conf. No.:	9105
Filed:	August 15, 2001	TC/A.U.:	2157
Examiner:	Sargon N. Nano	Appellant:	Noah J. Ternullo et al
Docket No.:	12078-142	Customer No.:	26486
Title:	METHOD AND APPARATUS FOR DELIVERING SERVICES IN A CONSTRAINED ENVIRONMENT		

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APPEAL BRIEF UNDER 37 C.F.R. § 41.37

Sir:

This is an appeal from the Final Rejection dated January October 13, 2006 (Final Rejection), of claims 1, 3-20, and 22-24, 29-42, 45 and 47 in the above-identified application. The Appeal Brief is timely filed, being filed on or before April 2, 2007, because April 1, 2007, two months following the date the Notice of Appeal was received by the USPTO, falls on a Sunday. The Director of Patents and Trademarks is hereby authorized to charge the appropriate large entity fee, $500 for an appeal brief filing, under 37 C.F.R. § 1.117(c), or to credit any overpayment of fees to Deposit Account No. 03-2410, Order No. 12078-142.

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I. REAL PARTY OF INTEREST

The real party in interest is the Assignee, Lockheed-Martin, Inc., having offices at Owego, NY.

II. RELATED APPEALS AND INTERFERENCES

None.

III. STATUS OF CLAIMS

Original claims 1, 3-20, and 22-24, 29-42, together with added claims 45 and 47, remain pending in this application. Claims 2, 21, 25-28, 43-44, and 46 were previously cancelled without prejudice. Claims 1, 19, 29, 35, and 47 are independent claims. Claims 1, 3-20, 22-24, 29-42, 45, and 47 were rejected under 35 U.S.C. § 103(a).

The claims currently on appeal are claims 1, 3-24, 29-42, and 47. However, dependent claims 4-5, 14, 16, 18, 20, 30, 36, and 45 have not been argued separately, but are considered patentable by virtue of the patentability of independent claims 1, 19, 29, and 35 and any other claims upon which they selectively depend. A copy of the claims on appeal is provided in the Claims Appendix.

IV. STATUS OF AMENDMENTS

The Response to the Final Rejection has been entered. The amended claims as entered from the response to the Final Rejection are the claims argued in this appeal brief and appear in the Claims Appendix of this appeal brief.

V. SUMMARY OF CLAIMED SUBJECT MATTER UNDER APPEAL

Independent claim 1 claims a method for utilizing an advertisement for a service for accessing the service, the service being relevant to a location of a client device at the location (Appellants' Specification, paragraph 46, FIG. 1A), said method comprising the steps of: formatting, outside the client device, unsolicited advertising information from the advertisement into XML elements

(Appellants' Specification, paragraphs 50 and 84, FIGs. 1A and 1B), the unsolicited advertising information including: service information indicating the purpose of the advertisement (Appellants' Specification, paragraph 14); data entry information indicating purchasing options based on the purpose (Appellants' Specification, paragraph 14); and contact information containing instructions for enabling the client device to communicate with the service (Appellants' Specification, paragraph 14); forming an advertising signal containing the unsolicited advertising information (Appellants' Specification, paragraph 13); propagating the advertising signal from a transmitter to the client device within the location (Appellants' Specification, paragraph 13); receiving the advertising signal at the client device (Appellants' Specification, paragraph 13, FIG. 19); decoding the advertising signal to extract the unsolicited advertising information (Appellants' Specification, paragraph 13); displaying the unsolicited advertising information to a user of the client device (Appellants' Specification, paragraph 13, FIG. 18); and determining, by the client device, a response to the advertising signal, based on the unsolicited advertising information (Appellants' Specification, paragraph 105, FIGs. 18 and 19).

Dependent claim 2 has been cancelled without prejudice.

Dependent claim 3 claims the method of claim 1 further comprising the steps of selecting the service based on the unsolicited advertising information and the response (Appellants' Specification, paragraph 151, FIG. 19, # 1916); communicatively coupling the client device with the selected service as a result of said step of selecting (Appellants' Specification, paragraph 151, FIG. 19, #s 1920-22); and communicating the selection and the response to the selected service (Appellants' Specification, paragraph 151, FIG. 19, #1926).

Dependent claim 4 claims the method of claim 3 further comprising the step of constructing a user interface for allowing the user to communicate with the client device (Appellants' Specification, paragraph 149, FIG. 17).

Dependent claim 5 claims the method of claim 4 further comprising the step of receiving user inputs in response to the unsolicited advertising information (Appellants' Specification, paragraph 150, FIG. 18, #1816).

Dependent claim 6 claims the method of claim 5 further comprising the step of formatting the user inputs, the response, and a portion of the unsolicited advertising information into a user reply, the

user reply for making the user inputs available to the service (Appellants' Specification, paragraph 55, FIG. 1B, #140).

Dependent claim 7 claims the method of claim 6 wherein the user reply is received at the transmitter (Appellants' Specification, paragraph 55, FIG. 1B, #110).

Dependent claim 8 claims the method of claim 7 wherein the user reply is received as a wireless signal from the client device (Appellants' Specification, paragraphs 47 and 51, FIG. 1B, #110, 131).

Dependent claim 9 claims the method of claim 7 wherein the user reply is received at the transmitter using a communication interface providing electromechanical contact between the client device and the transmitter (Appellants' Specification, paragraph 51, FIG. 1B, #131).

Dependent claim 10 claims the method of claim 9 further comprising the step of receiving a service response from the transmitter, the service response including executable code for allowing the client device to interact with the service (Appellants' Specification, paragraph 141, FIG. 15, #1506).

Dependent claim 11 claims the method of claim 6 wherein the user reply is sent directly from the client device to a point-of-presence (POP) (Appellants' Specification, paragraphs 47 and 51, FIG. 1B, #110).

Dependent claim 12 claims the method of claim 11 wherein the user reply is received over a personal digital assistant (PDA) interface providing electromechanical contact between the client device and the POP (Appellants' Specification, paragraph 51, FIG. 1B, #131).

Dependent claim 13 claims the method of claim 12 further comprising the step of receiving a service response from the POP, the service response including executable code for allowing the client device to interact with the service (Appellants' Specification, paragraph 141, FIG. 15, #1506).

Dependent claim 14 claims the method of claim 1 wherein the advertisement is propagated as an optical signal through air (Appellants' Specification, paragraphs 51, 52, and 84, FIG. 1B, #142).

Dependent claim 15 claims the method of claim 14 wherein the optical signal has a wavelength in the range of 850 nanometers to 1250 nanometers (Appellants' Specification, paragraph 88).

Dependent claim 16 claims the method of claim 15 wherein the transmitter receives the advertisement over an Internet (Appellants' Specification, paragraph 43, FIG. 1A, #104).

Dependent claim 17 claims the method of claim 15 wherein the transmitter receives the advertisement over a fiber optic network (Appellants' Specification, paragraph 42, FIG. 1A, #114).

Dependent claim 18 claims the method of claim 1 wherein the client device is a personal digital assistant (PDA) (Appellants' Specification, paragraph 53).

Independent claim 19 claims a method for conveying unsolicited information comprising the steps of preparing the unsolicited information by a service (Appellants' Specification, paragraphs 50 and 84, FIGs. 1A and 1B) including service information indicating the purpose of the information (Appellants' Specification, paragraph 14); data entry information indicating purchasing options based on the purpose (Appellants' Specification, paragraph 14); and contact information containing instructions for enabling the client device to communicate with the service (Appellants' Specification, paragraph 14); receiving the unsolicited information from the service into a transmitter outside the client device having a link layer (Appellants' Specification, paragraph 14); formatting the unsolicited information in the transmitter for transmission to a client device operating within a context associated with the transmitter (Appellants' Specification, paragraphs 84, FIGs. 1A and 1B); and conveying the unsolicited information from the transmitter to the client device over a communication medium (Appellants' Specification, paragraph 13).

Dependent claim 20 claims the method of claim 19 wherein the unsolicited information is comprised of an XML element (Appellants' Specification, paragraph 84).

Dependent claim 21 was cancelled without prejudice.

Dependent claim 22 claims the method of claim 19 wherein the unsolicited information is conveyed from the transmitter as a diffuse infrared signal (Appellants' Specification, paragraph 94).

Dependent claim 23 claims the method of claim 22 wherein the diffuse infrared signal has a wavelength in the range of 850 nanometers to 1250 nanometers (Appellants' Specification, paragraph 90).

Dependent claim 24 claims the method of claim 19 wherein the client device includes a client device physical layer and a client device link layer compatible with the link layer in the transmitter (Appellants' Specification, paragraph 94).

Dependent claims 25-28 were cancelled without prejudice.

Independent claim 29 claims a method of utilizing executable code in a transmitter for providing an advertisement to a client device (Appellants' Specification, paragraph 16), said method comprising the steps of receiving the advertisement by the executable code in the transmitter from a service provider about a service offered by the service provider (Appellants' Specification, paragraph

16); formatting the advertisement by the executable code in the transmitter for transmission to the client device operating within a coverage area of the transmitter (Appellants' Specification, paragraph 16); and conveying the advertisement by the executable code in the transmitter from the transmitter to the client device over a communication medium (Appellants' Specification, paragraph 16).

Dependent claim 30 claims the method of claim 29 wherein the advertisement is comprised of an XML element (Appellants' Specification, paragraph 63).

Dependent claim 31 claims the method of claim 30 wherein the advertisement further comprises service information enabling a user of the client device to make a decision about the service provider, the decision being based on the service information (Appellants' Specification, paragraph 14); data entry information informing the user about utilizing a service offered by the service provider (Appellants' Specification, paragraph 14); and contact information containing instructions for enabling the client device to communicate with the service provider (Appellants' Specification, paragraph 14).

Dependent claim 32 claims the method of claim 29 wherein the advertisement is conveyed from the transmitter as a diffuse infrared signal (Appellants' Specification, paragraph 94).

Dependent claim 33 claims the method of claim 32 wherein the diffuse infrared signal has a wavelength in the range of 850 nanometers to 1250 nanometers (Appellants' Specification, paragraph 90).

Dependent claim 34 claims the method of claim 33 wherein the diffuse infrared signal is generated by modulating an electric light (Appellants' Specification, paragraph 159).

Independent claim 35 claims a method of utilizing executable code in a client device (Appellants' Specification, paragraph 107) receiving an unsolicited, formatted advertisement from a transmitter located outside the client device (Appellants' Specification, paragraphs 50 and 84, FIGs. 1A and 1B), said method comprising the steps of receiving the unsolicited, formatted advertisement from an infrared communication signal conveyed from the transmitter (Appellants' Specification, paragraph 94), wherein the transmitter formatted the advertisement (Appellants' Specification, paragraphs 84, FIGs. 1A and 1B), and arriving at a communication interface associated with the client device, the unsolicited, formatted advertisement containing at least a portion of a service offered by a service provider (Appellants' Specification, paragraph 107); decoding, by the client device, the unsolicited, formatted advertisement to extract information contained therein (Appellants' Specification, paragraph 13); relating, by the client device, the information to user-specific data in the

client device (Appellants' Specification, paragraphs 127 and 128); and displaying, by the client device, the information related to the user-specific data to a user of the client device (Appellants' Specification, paragraphs 127 and 128).

Dependent claim 36 claims the method of claim 35 wherein said unsolicited, formatted advertisement is comprised of an XML element (Appellants' Specification, paragraph 84).

Dependent claim 37 claims the method of claim 36 wherein the unsolicited, formatted advertisement further comprises service information enabling the user to make a decision about the service (Appellants' Specification, paragraph 14), the decision based on the service information; data entry information informing the user about utilizing the service (Appellants' Specification, paragraph 14); and contact information containing instructions enabling the client device to communicate with the service provider (Appellants' Specification, paragraph 14).

Dependent claim 38 claims the method of claim 37 wherein the transmitter includes an emitter link layer (Appellants' Specification, paragraph 94).

Dependent claim 39 claims the method of claim 38 wherein the client includes a client device link layer (Appellants' Specification, paragraph 94).

Dependent claim 40 claims the method of claim 39 wherein the emitter link layer is compatible with the client device link layer (Appellants' Specification, paragraph 94).

Dependent claim 41 claims the method of claim 40 wherein the information about the service is displayed to the user if the client device is running a plug-in cooperatively associated with the service (Appellants' Specification, paragraphs 15 and 127).

Dependent claim 42 claims the method of claim 41 wherein the plug-in further comprises information about a preference of the user (Appellants' Specification, paragraphs 15 and 127).

Dependent claims 43-44 were cancelled without prejudice.

Dependent claim 45 claims the method of claim 19 wherein the unsolicited information is conveyed from the transmitter as a radio frequency (RF) signal (Appellants' Specification, paragraph 42).

Dependent claim 46 was cancelled without prejudice.

Independent claim 47 claims a method for determining a user response to predetermined information relevant to a client device at the location, said method comprising the steps of formatting, outside the client device, the predetermined information (Appellants' Specification, paragraphs 50 and

84, FIGs. 1A and 1B) including service information indicating the purpose of the service (Appellants' Specification, paragraph 14); data entry information indicating options based on the purpose (Appellants' Specification, paragraph 14); and contact information enabling the client device to communicate with the service (Appellants' Specification, paragraph 14); forming a signal containing the predetermined information (Appellants' Specification, paragraph 13); propagating the signal from a transmitter to the client device within the location; receiving the signal at the client device (Appellants' Specification, paragraph 13); extracting the predetermined information (Appellants' Specification, paragraph 13); and determining, by the client device, a user response to the predetermined information from user eye movement (Appellants' Specification, paragraph 105 and 153, FIGs. 18 and 19).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The Examiner has rejected claims 1, 3-20, 22-24, 29-42, and 45 under 35 U.S.C. § 103(a) as being unpatentable over Hendrey et al, United States Patent # 6,647,269, issued on November 11, 2003, filed on July 5, 2001, published on August 1, 2002 (Hendrey), in view of Weiss et al., United States Patent # 6,738,951, issued on May 18, 2004, filed on December 9, 1999 (Weiss).

The Examiner has rejected independent claim 47 under 35 U.S.C. § 103(a) as being unpatentable over Hendrey in view of Kahn et al., United States Patent # 5,844,544, issued on December 1, 1998 (Kahn).

It is submitted that the combination of Hendrey and Weiss do not make obvious Appellants' claimed invention for the following reasons:

(a) Hendrey and Weiss do not make obvious Appellants' claimed formatting, outside the client device, unsolicited advertising information into XML elements (independent claim 1);

(b) Hendrey and Weiss do not make obvious Appellants' claimed unsolicited advertising information including data entry information indicating purchasing options (independent claim 1);

(c) Hendrey and Weiss do not make obvious Appellants' claimed step of receiving the advertising signal (formatted into XML elements) at the client device (independent claim 1);

(d) Hendrey and Weiss do not make obvious Appellants' claimed step of determining, by the client device, a response to the advertising signal, based on the unsolicited advertising information (independent claim 1);

(e) Hendrey and Weiss do not make obvious Appellants' claimed step of communicatively coupling the client device with the selected service (dependent claim 3);

(f) Hendrey and Weiss do not make obvious Appellants' claimed step of communicating the selection and the response to the selected service (dependent claim 3);

(g) Hendrey and Weiss do not make obvious Appellants' claimed step of communicating the selection and the response to the selected service (dependent claim 6);

(h) Hendrey and Weiss do not make obvious Appellants' claimed user reply and its various methods of transmission (dependent claims 7, 8, 9, 11, and 12);

(i) Hendrey and Weiss do not make obvious Appellants' claimed step of receiving a service response from the transmitter or POP, the service response including executable code for allowing the client device to interact with the service (dependent claims 10 and 13);

(j) Hendrey and Weiss do not make obvious Appellants' claimed step of conveying unsolicited information from a transmitter as an optical signal or a diffuse infrared signal having a wavelength range of 850-1250 nanometers (dependent claims 15, 23, and 33);

(k) Hendrey and Weiss do not make obvious Appellants' claimed transmitter that receives the advertisement over a fiber optic network (dependent claim 17);

(l) Hendrey and Weiss do not make obvious Appellants' claimed transmitter outside the client device having a link layer, or a client device physical layer and a client device link layer compatible with the link layer in the transmitter or emitter (independent claim 19 and dependent claims 24 and 38-40);

(m) Hendrey and Weiss do not make obvious Appellants' claimed unsolicited information or advertisement conveyed from the transmitter as a diffuse infrared signal (dependent claims 22 and 32) or an infrared communications signal (independent claim 35);

(n) Hendrey and Weiss do not make obvious Appellants' claimed steps of receiving an advertisement in the transmitter from a service provider, and conveying the advertisement by the executable code in the transmitter to the client device (independent claim 29);

(o) Hendrey and Weiss do not make obvious Appellants' claimed advertisement including data entry information (dependent claims 31 and 37);

(p) Hendrey and Weiss do not make obvious Appellants' claimed diffuse infrared signal generated by modulating an electric light (dependent claim 34);
(q) Hendrey and Weiss do not make obvious Appellants' claimed wherein the information about the service is displayed to the user if the client device is running a plug-in cooperatively associated with the service (dependent claim 41); and
(r) Hendrey and Weiss do not make obvious Appellants' claimed wherein the plug-in further comprises information about a preference of the user (dependent claim 42).

The Examiner has rejected independent claim 47 under 35 U.S.C. § 103(a) as being unpatentable over Hendrey in view of Kahn et al., United States Patent # 5,844,544, issued on December 1, 1998 (Kahn).

It is submitted that the combination of Hendrey and Kahn do not make obvious Appellants' claimed invention (claim 47) for the following reasons:
(s) Hendrey and Kahn do not make obvious Appellants' claimed predetermined information including data entry information indicating options based on the purpose of the service (independent claim 47); and
(t) Hendrey and Kahn do not make obvious Appellants' claimed step of determining, by the client device, a user response to the predetermined information from user eye movement (independent claim 47).

The remaining claims 4-5, 14, 16, 18, 20, 30, 36, and 45 which depend from any one of the claims listed above are therefore not rendered obvious for the reasons stated below.

VII. ARGUMENT

It is submitted that the references, Hendrey and Weiss, do not make obvious the invention as required by claims 1, 3-20, 22-24, 29-42, and 45 because in order for a rejection under 35 U.S.C. §103 to be sustained, the Examiner must establish a *prima facie* case of obviousness. To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the reference itself or in the knowledge generally available to one of ordinary skill in the art, to modify the reference. Second, there must be a reasonable expectation of success. Finally, the prior art reference must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the

prior art, not in Appellants' disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Further, obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art.

(a) Hendrey and Weiss do not make obvious Appellants' claimed formatting, outside the client device, unsolicited advertising information into XML elements (independent claim 1).

It is submitted that Hendrey and Weiss so not make obvious Appellants' claimed formatting, outside the client device, unsolicited advertising information into XML elements (Appellants' independent claim 1) because (1) Hendrey does not disclose any formatting whatsoever, and (2) Weiss does not make up for Hendrey's deficiency because Weiss converts documents into Braille, not XML. With respect to (1), Hendrey does not format advertisements into XML because Hendrey's advertisement generation subsystem is limited to generating advertising content, creating an advertisement about a particular set of goods, and generating an advertisement relevant to a proximately located business (Hendrey, col. 4, lines 29-55), with no formatting capability described or suggested. With respect to (2), Weiss does not make up for Hendrey's deficiency because Weiss's system converts XML documents into Braille (Weiss, col. 4, lines 54-65). In the Final Rejection on page 13 in paragraph 4, the Examiner states that "Weiss teaches the documents are reformatted to and from XML outside the client device", and that "once the document is being transmitted a proxy server that resides outside the client device, reformats and transcodes the documents into XML, HTML, etc." It is submitted that nowhere does Weiss state that documents are "reformatted *to* and from XML". The relevant passages from Weiss follow:

> Transcoder proxy 32 receives electronic documents (e.g., document 12) from internet server 16 in digital format. Well known digital formats include text-based markup language formats such as hypertext markup language (HTML) and extensible markup language (XML). . . . As illustrated in FIG. 1, transcoder proxy 32 includes a rule set 34. Rule set 34 includes rules for *translating document 12* ***from*** *any one of several digital document formats (e.g., HTML, XML, POSTSCRIPT, PDF, etc.)* ***to*** *any one of various Braille formats* (e.g., English Braille, European

> Braille, Japanese Braille, and/or a grade such as grade 1 or grade 2). (Weiss, col. 4, lines 54-66).
>
> Electronic document 12 includes one or more elements representing document structures. . . . Transcoder proxy 32 uses the Braille format information and/or the Braille display information (i.e., the cell count and/or the pin count), provided by client machine 22 during system initialization and/or during system use, to select rules within rule set 34 in order to *translate document 12* ***from*** *one digital format (e.g., HTML, XML, POSTSCRIPT, PDF, etc.)* ***to*** *a script written in a scripting language understood by user agent 28 within client machine 22.* (Weiss, col. 5, lines 18-29)

Clearly, Weiss is limited to translating from XML to Braille, but not the reverse.

(b) Hendrey and Weiss do not make obvious Appellants' claimed unsolicited advertising information including data entry information indicating purchasing options (independent claim 1).

It is submitted that Hendrey and Weiss do not make obvious Appellants' claimed unsolicited advertising information including data entry information indicating purchasing options because (1) Hendrey's mobile unit (Appellants' claimed client device) does not provide for data entry, and therefore teaches away from the need for data entry information, and (2) Weiss does not make up for Hendrey's deficiency because Weiss's mobile unit does not receive unsolicited advertising information including data entry information. With respect to (1), Hendrey does not disclose or suggest Appellants' claimed data entry information because Hendrey's mobile unit does not accept data entry, but simply allows itself to be tracked when it is near a particular business (Hendrey, col. 4, lines 15-26). With respect to (2), Weiss's documents are not advertisements that include data entry information because any data entry information in Weiss is described to be part of a separate structure, the logical structure of the electronic document, having methods for accessing and manipulating the document (Weiss, col. 3, lines 2-14), but not included in the documents that are transcoded and sent to the client.

(c) Hendrey and Weiss do not make obvious Appellants' claimed step of receiving the advertising signal (formatted into XML elements) at the client device (independent claim 1).

It is submitted that Hendrey and Weiss do not make obvious Appellants' claimed steps of receiving the unsolicited advertising signal (formatted into XML elements) at the client device, because (1) Hendrey's client does not receive XML elements, and (2) Weiss does not make up for Hendrey's deficiency because Weiss does not receive XML elements. With respect to (1), nowhere does Hendrey make reference to any particular format, including XML, and thus does not describe the capability of processing XML elements. With respect to (2), Weiss's transcoder proxy, executing in a server that is separate from Weiss's client (Weiss, FIG. 2, ref. #s 32 and 22, respectively), receives documents in various formats and converts them to Braille (Weiss, col. 4, lines 54-66), which Weiss specifically states the client receives in a Braille format (Weiss, col. 3, lines 11-22).

(d) Hendrey and Weiss do not make obvious Appellants' claimed step of determining, by the client device, a response to the advertising signal, based on the unsolicited advertising information (independent claim 1).

It is submitted that Hendrey and Weiss do not make obvious Appellants' claimed step of determining, by the client device, a response to the advertising signal, based on the unsolicited advertising information because (1) Hendrey's client device does not determine a response to the advertising signal except to display the advertisement, a step which Appellants claim separately, and (2) Weiss does not make up for Hendrey's deficiency because Weiss's client displays an electronic document but does not determine a response to the document based on the document, and has no interaction whatsoever with an advertising signal. With respect to (1), in a conversation with the Examiner on November 29, 2006, the Examiner indicated that Hendry's response by the client device to an advertising signal was to display the advertisement. As stated above, Appellants claim, *both* the steps of displaying the advertising information to the user of the client device, *and* the step of determining, by the client device, a response to the advertising signal. With further reference to (1), in the Final Rejection on page 13 in paragraph 4, the Examiner states that the prospective user or potential customer responds to the tailored advertising message by walking into the stores, and this constitutes the user response to the unsolicited advertisement. In rebuttal, it is submitted that Appellants' claimed client device, from the totality of independent claim 1 and from Appellants'

Specification, is clearly an electronic device, and a response from an electronic device would be in electronic form, not a physical action by a user.

(e) Hendrey and Weiss do not make obvious Appellants' claimed step of communicatively coupling the client device with the selected service (dependent claim 3).

It is submitted that Hendrey and Weiss do not make obvious Appellants' claimed communicatively coupling the client device with the selected service (selected based on the unsolicited advertising information) because (1) Hendrey's communicative coupling with Hendrey's tracking system does not result from Appellants' claimed selecting a service based on unsolicited advertising, and (2) Weiss cannot make up Hendrey's deficiency because Weiss's communicative coupling is not related to selecting a service based on unsolicited advertising. With respect to (1), any communicative coupling involving Hendrey's mobile unit would be with Hendrey's location tracking system which is not associated with Appellants' claimed selected service based on unsolicited advertising information and the response, but instead Hendrey's location tracking system is associated with many stores, whereas Appellants' claim a coupling between the client device and the selected service associated with the advertisement. In fact, Hendrey teaches away from Appellants' claimed step of communicatively coupling the client device with the selected service because Hendrey states that upon detecting entry of a user to a particular business location, generation subsystem 131 may generate an advertisement for goods or services at lower prices at some other competing business (Hendrey, col. 4, lines 51-55). A business that was communicatively coupled with a client device would not advertise for other businesses having lower prices.

(f) Hendrey and Weiss do not make obvious Appellants' claimed step of communicating the selection and the response to the selected service (dependent claim 3).

It is submitted that Hendrey and Weiss do not make obvious Appellants' claimed communicating the selection and the response to the selected service because (1) Hendrey's mobile unit does not accept a selection or response to unsolicited advertisement to communicate, and

communication from Hendrey's mobile unit is limited to tracking information, and (2) Weiss does not make up for Hendrey's deficiency because neither does Weiss accept a selection and response to unsolicited advertisement that can be communicated. With respect to (1), Hendrey does describe user input at the mobile unit with respect to the unsolicited advertisement, nor does Hendrey's mobile unit automatically select a service based on unsolicited advertisement because Hendrey's location tracking isn't a "selected" service, one that would be selected based on the unsolicited advertising, and because Hendrey's location tracking device isn't disclosed to accept any such selections, even if they were transmitted. With respect to (2), any user input in Weiss is limited to an elected Braille format (Weiss, col. 5, lines 5-6), document request, and document manipulation (Weiss, col. 5, lines 53-65).

(g) Hendrey and Weiss do not make obvious Appellants' claimed step of communicating the selection and the response to the selected service (dependent claim 6).

It is submitted that Hendrey and Weiss do not make obvious Appellants' claimed step of formatting the user inputs, the response, and a portion of the unsolicited advertising information into a user reply to make the user inputs available to the service because (1) Hendrey does not format unsolicited advertising information into a user reply, and (2) Weiss does not make up for Hendrey's deficiency because Weiss neither receives nor formats unsolicited advertising information. With respect to (1), Hendrey does not format advertising information into a user reply because, as the Final Rejection states (Final Rejection, page 13, paragraph 4), Hendrey's "user reply" consists of the user's physically moving from place to place, but there is no formatting associated with such movement. Hendrey's device does not accept a user reply as is commonly understood in the art, for example, the user's completing an on-line form. With respect to (2), Weiss does not format advertising information into a user reply because Weiss neither receives advertising information nor accepts user input as a result of advertising. Weiss's user input is limited to an elected Braille format, document request, and document manipulation, none of which is related to unsolicited advertising.

(h) Hendrey and Weiss do not make obvious Appellants' claimed user reply and its various methods of transmission (dependent claims 7, 8, 9, 11, and 12).

It is submitted that Hendrey and Weiss do not make obvious Appellants' claimed user reply received at the transmitter (dependent claim 6) as a wireless signal from the client device (dependent claim 8) or using a communication interface providing electromechanical contact between the client device and the transmitter (dependent claim 9) or received over a PDA interface providing electromechanical contact between the client device and a point-of-presence (POP) (dependent claim 12) or the user reply is received over a PDA interface providing electromechanical contact between the client device and the POP (dependent claim 11) because (1) Hendrey's mobile unit does not provide a user reply that includes a portion of the unsolicited advertising information, and (2) Weiss does not make up for Hendrey's deficiency because Weiss does not provide a user reply that includes a portion of the unsolicited advertising information. With respect to (1), Hendrey does not provide a user reply that includes a portion of the unsolicited advertisement because Hendrey's mobile unit is limited to communicating with Hendrey's location tracking system which is simply tracking the physical location of the mobile unit, but is not receiving communications from the mobile unit with respect to the unsolicited advertisement. With respect to (2), Weiss does not provide a user reply that includes a portion of the unsolicited advertisement because Weiss's client device is limited to providing to the server an elected Braille format and the URL of a document that is being requested (Weiss, col. 4, lines 25-53), but no user reply including a portion of the unsolicited advertising information because Weiss's communication from the client device, a document URL and a Braille format selection, is not in response to an advertisement of any kind.

(i) Hendrey and Weiss do not make obvious Appellants' claimed step of receiving a service response from the transmitter or POP, the service response including executable code for allowing the client device to interact with the service (dependent claims 10 and 13).

It is submitted that Hendrey and Weiss do not make obvious Appellants' claimed receiving a service response from the transmitter or POP, the service response including executable code for

allowing the client device to interact with the service, because (1) nowhere does Hendrey disclose or suggest that executable code is transmitted by a transmitter to Hendrey's mobile unit, and (2) Weiss does not make up for Hendrey's deficiency because Weiss does not disclose or suggest that executable code is transmitted from Weiss's server to Weiss's client. With respect to (1), Hendrey does not disclose or suggest the transmission of executable code to Hendrey's mobile unit because Hendrey limits the transmissions between the tracking system and the mobile unit to "data". A relevant passage from Hendrey follows:

> The term "connection" [between a stationary unit and a mobile unit, see Hendrey, col. 3, lines 9-25] bears specific discussion. Although the notion of a connection obviously encompasses traditional voice phone calls, it furthermore encompasses any and all modalities of *data* transfer between TUs. This includes, for example, voice phone calls, video phone calls, digital camera picture transfers, general multimedia data transfers, television feeds, movies, e-mail, voice mail, prerecorded messages, data to create synthesized/reconstructed voice messages, map information, geographic coordinate data, World Wide Web content and World Wide Web pointers. (Hendrey, col. 8, line 64 – col. 9, line 10)

Executable code is not "data" but is code that acts upon data. With respect to (2), Weiss's system is limited to transferring a document, a URL, and a Braille format, none of which can be categorized as executable code.

(j) Hendrey and Weiss do not make obvious Appellants' claimed step of conveying unsolicited information from a transmitter as an optical signal or a diffuse infrared signal having a wavelength range of 850-1250 nanometers (dependent claims 15, 23, and 33).

It is submitted that Hendrey and Weiss do not make obvious Appellants' claimed step of conveying unsolicited information from a transmitter as an optical signal or a diffuse infrared signal having a wavelength range of 850-1250 nanometers because neither Hendrey nor Weiss describes the interface between the mobile unit or client and the telecommunication system infrastructure beyond the obvious requirement that the mobile unit have a wireless interface. Appellants claim a particular type of signal, an optical signal (dependent claim 15) or a diffuse infrared signal (dependent claims 23 and

33), having a particular wavelength range, 850-1250 nanometers. There are many types of wireless communications, wireless optical and diffuse infrared being only two, and many possible wavelength ranges. For example, AIRFIBER® OPTIMESH® wireless optical network transmits at 785 nanometers, while several other wireless optical systems use 1550 nanometer wavelength laser (Alwan, Jim, *Eye Safety and Wireless Optical Networks (WONS)*, White Paper 802-0004-000, AirFiber, Inc., 2001, p. 8, (Attachment A)), http://www.systemsupportsolutions.com/whitepapers/WP_laser_eye_safety.pdf), neither of which is within Appellants' claimed range. For a further example, Kahn et al. state that "a wavelength band near 800 nanometers is probably the best choice for diffuse infrared communications" (Kahn et al., Introduction to *High-Speed Non-Directional Infrared Communication for Wireless Local-Area Networks*, Department of Electrical Engineering and Computer Sciences, University of California, Berkeley, CA 94720, http://iss.bu.edu/jbc/Publications/jbc-c2.pdf (Attachment B)). Clearly, Appellants' choice of wavelength range is not obvious, and is out of the scope of the disclosures of both Hendrey and Weiss. Further, the nature of a diffuse infrared signal is that it is limited to an enclosed area. Neither Hendrey nor Weiss places such a restriction on its transmission capabilities.

(k) Hendrey and Weiss do not make obvious Appellants' claimed transmitter that receives the advertisement over a fiber optic network (dependent claim 17).

It is submitted that Hendrey and Weiss do not make obvious Appellants' claimed transmitter that receives the advertisement over a fiber optic network because (1) Hendrey does not receive the advertisement at the transmitter (for example, Hendrey's tracking system), and (2) Weiss does not make up for Hendrey's deficiency because Weiss does not receive advertisements at all. With respect to (1), Hendrey's tracking system creates advertisements (Hendrey, col. 4, lines 27-32) but does not receive them at a transmitter over a fiber optic network. The totality of Appellants' claimed invention aligns Appellants' claimed transmitter with Hendrey's tracking system, not with Hendrey's mobile unit which can receive advertisements, because both Appellants' transmitter and Hendrey's tracking system transmit to a mobile unit. With respect to (2), Weiss receives *requested* documents, but nowhere does

Weiss disclose or suggest receiving advertisements which are described throughout Appellants' Specification as *unrequested* information.

(l) Hendrey and Weiss do not make obvious Appellants' claimed transmitter outside the client device having a link layer, or a client device physical layer and a client device link layer compatible with the link layer in the transmitter or emitter (independent claim 19 and dependent claims 24 and 38-40).

It is submitted that Hendrey and Weiss do not make obvious Appellants' claimed transmitter outside the client device having a link layer (independent claim 19), or a client device physical layer and a client device link layer compatible with the link layer in the transmitter (dependent claim 24), because neither Hendrey nor Weiss describe any transmission layers, including a link layer, in the transmitter or client device. As pointed out in *RF Protocol Design and Reconfigurable Logic Implementation for Low Power Appellants*, Alvarez et al., Facultad de Informatica UPV/EHU, San Sebastian, Gipuzkoa, Spain, 2003 (Attachment C) "some commercial transceivers include the physical and Media Access Control layers, . ," but "other transceivers need all the protocol layers". Details about the transmission layers, including Appellants' claimed link layer, are beyond the scope of both Hendrey and Weiss.

(m) Hendrey and Weiss do not make obvious Appellants' claimed unsolicited information or advertisement conveyed from the transmitter as a diffuse infrared signal (dependent claims 22 and 32) or an infrared communications signal (independent claim 35).

It is submitted that Hendrey and Weiss do not make obvious Appellants' claimed unsolicited information or advertisement conveyed from the transmitter as a diffuse infrared signal or infrared communications signal because (1) Hendrey teaches away from a diffuse infrared signal because there are no restrictions on where the recipient of the advertisement can be physically located, and (2) Weiss does not make up for Hendrey's deficiency because Weiss states no restrictions on the recipient either. It is well-known that several technologies exist to transmit signals wirelessly, none of which are

described by either Hendrey or Weiss. Further, Appellants' claimed diffuse infrared signals are effective in closed areas like rooms, whereas neither Hendrey nor Weiss states qualifications on wireless capability.

(n) Hendrey and Weiss do not make obvious Appellants' claimed steps of receiving an advertisement in the transmitter from a service provider, and conveying the advertisement by the executable code in the transmitter to the client device (independent claim 29).

It is submitted that Hendrey and Weiss do not make obvious Appellants' claimed steps of receiving an advertisement in the transmitter from a service provider and conveying the advertisement by the executable code in the transmitter to the client device because (1) Hendrey does not receive advertisements and convey them but simply prepares advertisements and conveys them, and (2) Weiss does not make up this deficiency in Hendrey because Weiss does not receive advertisements and convey them but instead receives *requested* documents (Weiss, col. 1, lines 36-41) and conveys them. With respect to (1), Hendrey does not receive advertisements because Hendrey's tracking system prepares the advertisements (Hendrey, col. 4, lines 27-32). Hendrey alludes to advertising content's being provided by the store (Hendrey, col. 3, line 66 – col. 4, line 1), but nowhere enables that capability. In fact, Hendrey teaches away from Appellants' claimed receiving the advertisement by the executable code in the transmitter from a service provider because Hendrey states that advertisements are "created" and "generated" by the advertising content generation subsystem 131. With respect to (2), Weiss does not receive advertisements because Weiss's user agent must provide the URL of a requested document as indicated by the user of a Braille display (Weiss, col. 4, lines 44-48). An advertisement does not fall into the category of documents that are described by Weiss because an advertisement is not a requested document. Services that could result from a user's response to an advertisement could be requested, but the impetus to convey an advertisement comes from a service provider or manufacturer, not from a user of a Braille display.

(o) Hendrey and Weiss do not make obvious Appellants' claimed advertisement including data entry information (dependent claims 31 and 37).

It is submitted that Hendrey and Weiss do not make obvious Appellants' claimed advertisement including data entry information because (1) Hendrey's mobile unit (Appellants' claimed client device) does not provide for data entry, and therefore teaches away from the need for data entry information, and (2) Weiss does not make up Hendrey's deficiency because Weiss's mobile unit does not receive advertisements including data entry information. With respect to (1), Hendrey does not describe Appellants' claimed advertisement including data entry information because Hendrey's mobile unit does not accept data entry with respect to the advertisement, but simply allows itself to be tracked when it is near a particular business (Hendrey, col. 4, lines 15-26). With respect to (2), Weiss's documents are requested and are therefore not advertisements. Further, Weiss's documents are not described to include data entry information.

(p) Hendrey and Weiss do not make obvious Appellants' claimed diffuse infrared signal generated by modulating an electric light (dependent claim 34).

It is submitted that Hendrey and Weiss so not make obvious Appellants' claimed diffuse infrared signal generated by modulating an electric light because (1) Hendrey does not describe how the wireless signal is generated, and (2) Weiss does not make up for Hendrey's deficiency because Weiss does not describe what generates the signal the wireless device receives. It is well-known that infrared signals can be generated in a variety of ways, modulated electric light being only one of them. Neither Hendrey nor Weiss describes any ways to generate a wireless signal, and they do not describe any limitations placed on users of their systems to accommodate Appellants' claimed diffuse infrared signal generated by modulating an electric light.

(q) Hendrey and Weiss do not make obvious Appellants' claimed wherein the information about the service is displayed to the user if the client device is running a plug-in cooperatively associated with the service (dependent claim 41).

It is submitted that Hendrey and Weiss do not make obvious Appellants' claimed wherein the information about the service is displayed to the user if the client device is running a plug-in cooperatively associated with the service because neither Hendrey nor Weiss describe a conditional display based on a plug-in running in a mobile unit or client. Hendrey's description of a mobile unit that displays advertisements makes advertisement transmission dependent upon processing occurring external to the mobile unit, and thus does not have any display condition dependent upon a plug-in running in the mobile unit. Weiss does not make up for Hendrey's deficiency because Weiss's client is not described to be running plug-ins, which are structures that give the capability of loading extra functionality into an application at run time. There is no described need for such a structure in Weiss, and no conditional display based on the execution of such a structure.

(r) Hendrey and Weiss do not make obvious Appellants' claimed wherein the plug-in further comprises information about a preference of the user (dependent claim 42).

It is submitted that Hendrey and Weiss so not make obvious Appellants' claimed wherein the plug-in (running in the client device) further comprises information about a preference of the user because (1) Hendrey's user preferences, if any, are established in the tracking system which is remote from the client device (Hendrey, FIG. 1), and (2) Weiss does not make up for Hendrey's deficiency because Weiss's user preferences are not maintained in a plug-in in the client. With respect to (1), Hendrey's mobile unit does not contain user preferences with respect to the received advertising, including any being maintaining in a plug-in, because Hendrey's *tracking system*, not Hendrey's mobile unit, includes a profile of the user (Hendrey, col. 4, lines 27-44). With respect to (2), Weiss does not describe a plug-in containing information about the preference of the user because Weiss's preference is limited to a Braille format selection at initialization, or during system use (Weiss, col. 4, lines 31-35), and Weiss does not describe a structure such as a plug-in to include the selection of a

Braille format. Extra functionality that a plug-in could supply is not described to be needed in Weiss to change the Braille format because Weiss states a list of pre-selected Braille formats from which the user can choose.

(s) Hendrey and Kahn do not make obvious Appellants' claimed predetermined information including data entry information indicating options based on the purpose of the service (independent claim 47).

It is submitted that Hendrey and Kahn do not make obvious Appellants' claimed predetermined information including data entry information indicating options based on the purpose of the service because (1) Hendrey's mobile unit (Appellants' claimed client device) does not provide for data entry, and therefore teaches away from the need for data entry information, and (2) Weiss does not make up for Hendrey's deficiency because Weiss's mobile unit does not receive predetermined information including data entry information. With respect to (1), Hendrey does not disclose or suggest Appellants' claimed data entry information because Hendrey's mobile unit does not accept data entry, but simply allows itself to be tracked when it is near a particular business (Hendrey, col. 4, lines 15-26). With respect to (2), Weiss's description of data entry is limited to manipulation of the document provided by the service and selection of a Braille format. The manipulation of the transcoded document is not related to the options of the transcoding service, and the selection of the Braille format is not associated with the transcoded document.

(t) Hendrey and Kahn do not make obvious Appellants' claimed step of determining, by the client device, a user response to the predetermined information from user eye movement (independent claim 47).

It is further submitted, with respect to independent claim 47, that neither Hendrey nor Kahn nor their combination makes obvious Appellants' claimed determining, by the client device, a user response to the predetermined information from user eye movement because (1) as the Final Rejection states, Hendrey fails to explicitly teach the user response in the form of eye movement (Final Rejection, page 12, paragraph 3), and (2) Kahn does not make up for Hendrey's deficiency because *Uniroyal v. Rudkin-Wiley,* 5 U.S.P.Q.2d 1434, 1438 (Fed. Cir. 1988) teaches that for prior art

references to be combined to render obvious a subsequent invention under 35 U.S.C. § 103, there must be something in the prior art as a whole that suggests the desirability, and thus the obviousness, of making the combination. With respect to (2), because Hendrey does not require user input into the mobile unit with respect to the advertisement, and because Kahn doesn't interface with a wireless device, nothing in the prior art as a whole suggests the desirability of combining Hendrey and Kahn, and in fact Hendrey teaches away from such a combination because Hendrey's purpose is to present information to the user, not to accept user input. Further, *In re Fritch*, 23 U.S.P.Q.2d 1780, 1783 (Fed. Cir. 1992) teaches that the mere fact that a prior art structure could be modified to produce the claimed invention would not have made the modification obvious unless the prior art suggested the desirability of the modification.

(u) Dependent claims 4-5, 14, 16, 18, 20, 30, 36, and 45 are patentable at least by virtue of their dependence upon allowable independent claims.

It is submitted that dependent claims 4-5, 14, 16, 18, 20, 30, 36, and 45 are patentable at least by virtue of their selected dependence upon allowable independent claims 1, 19, 29, and 35.

VIII. CONCLUSION

It is quite clear from the arguments presented above that claims 1, 3-20, 22-24, 29-42, 45, and 47 are not made obvious by Hendrey, Weiss, or Kahn, either separately or in combination, therefore completely negating the 35 U.S.C. §103 rejections applied thereto.

In view of the law and facts stated herein, Appellants respectfully submit that Hendrey, Weiss, and Kahn are insufficient to make obvious Appellants' claims 1, 3-20, 22-24, 29-42, 45, and 47. Appellants respectfully urge that the rejection of claims 1, 3-20, 22-24, 29-42, 45, and 47 under 35 U.S.C. § 103 are improper. Reversal of the rejections in this appeal is respectfully requested.

In accordance with M.P.E.P. § 714.01, the following information is presented in the event that a call may be deemed desirable by the Examiner:

KATHLEEN CHAPMAN (617) 345-3210

Dated: March 15, 2007

Respectfully submitted
on behalf of Appellants,
Noah Ternullo et al.

Reg # 24,338

By: _____
Kathleen Chapman
Reg. No. 46,094
Attorney for Appellants

IX. CLAIMS APPENDIX

This listing of claims replaces all prior versions, and listings, of claims in the application:

Listing of claims

Claim 1: (previously presented) A method for utilizing an advertisement for a service for accessing the service, the service being relevant to a location of a client device at the location, said method comprising the steps of:

formatting, outside the client device, unsolicited advertising information from the advertisement into XML elements, the unsolicited advertising information including:

service information indicating the purpose of the advertisement;

data entry information indicating purchasing options based on the purpose; and

contact information containing instructions for enabling the client device to communicate with the service;

forming an advertising signal containing the unsolicited advertising information;

propagating the advertising signal from a transmitter to the client device within the location;

receiving the advertising signal at the client device;

decoding the advertising signal to extract the unsolicited advertising information;

displaying the unsolicited advertising information to a user of the client device; and

determining, by the client device, a response to the advertising signal, based on the unsolicited advertising information.

Claim 2: (cancelled)

Claim 3: (previously presented) The method of claim 1 further comprising the steps of:

selecting the service based on the unsolicited advertising information and the response;

communicatively coupling the client device with the selected service as a result of said step of selecting; and

communicating the selection and the response to the selected service.

Claim 4: (previously presented) The method of claim 3 further comprising the step of constructing a user interface for allowing the user to communicate with the client device.

Claim 5: (previously presented) The method of claim 4 further comprising the step of receiving user inputs in response to the unsolicited advertising information.

Claim 6: (previously presented) The method of claim 5 further comprising the step of formatting the user inputs, the response, and a portion of the unsolicited advertising information into a user reply, the user reply for making the user inputs available to the service.

Claim 7: (previously presented) The method of claim 6 wherein the user reply is received at the transmitter.

Claim 8: (previously presented) The method of claim 7 wherein the user reply is received as a wireless signal from the client device.

Claim 9: (previously presented) The method of claim 7 wherein the user reply is received at the transmitter using a communication interface providing electromechanical contact between the client device and the transmitter.

Claim 10: (previously presented) The method of claim 9 further comprising the step of receiving a service response from the transmitter, the service response including executable code for allowing the client device to interact with the service.

Claim 11: (previously presented) The method of claim 6 wherein the user reply is sent directly from the client device to a point-of-presence (POP).

Claim 12: (previously presented) The method of claim 11 wherein the user reply is received over a personal digital assistant (PDA) interface providing electromechanical contact between the client device and the POP.

Claim 13: (previously presented) The method of claim 12 further comprising the step of receiving a service response from the POP, the service response including executable code for allowing the client device to interact with the service.

Claim 14: (previously presented) The method of claim 1 wherein the advertisement is propagated as an optical signal through air.

Claim 15: (previously presented) The method of claim 14 wherein the optical signal has a wavelength in the range of 850 nanometers to 1250 nanometers.

Claim 16: (previously presented) The method of claim 15 wherein the transmitter receives the advertisement over an Internet.

Claim 17: (previously presented) The method of claim 15 wherein the transmitter receives the advertisement over a fiber optic network.

Claim 18: (previously presented) The method of claim 1 wherein the client device is a personal digital assistant (PDA).

Claim 19: (previously presented) A method for conveying unsolicited information comprising the steps of:

preparing the unsolicited information by a service including:

service information indicating the purpose of the information;

data entry information indicating purchasing options based on the purpose; and

contact information containing instructions for enabling the client device to communicate with the service;

receiving the unsolicited information from the service into a transmitter outside the client device having a link layer;

formatting the unsolicited information in the transmitter for transmission to a client device operating within a context associated with the transmitter; and

conveying the unsolicited information from the transmitter to the client device over a communication medium.

Claim 20: (previously presented) The method of claim 19 wherein the unsolicited information is comprised of an XML element.

Claim 21: (cancelled)

Claim 22: (previously presented) The method of claim 19 wherein the unsolicited information is conveyed from the transmitter as a diffuse infrared signal.

Claim 23: (previously presented) The method of claim 22 wherein the diffuse infrared signal has a wavelength in the range of 850 nanometers to 1250 nanometers.

Claim 24: (previously presented) The method of claim 19 wherein the client device includes a client device physical layer and a client device link layer compatible with the link layer in the transmitter.

Claim 25: (cancelled)
Claim 26: (cancelled)
Claim 27: (cancelled)
Claim 28: (cancelled).

Claim 29: (previously presented) A method of utilizing executable code in a transmitter for providing an advertisement to a client device, said method comprising the steps of:

receiving the advertisement by the executable code in the transmitter from a service provider about a service offered by the service provider;

formatting the advertisement by the executable code in the transmitter for transmission to the client device operating within a coverage area of the transmitter; and

conveying the advertisement by the executable code in the transmitter from the transmitter to the client device over a communication medium.

Claim 30: (previously presented) The method of claim 29 wherein the advertisement is comprised of an XML element.

Claim 31: (previously presented) The method of claim 30 wherein the advertisement further comprises:

service information enabling a user of the client device to make a decision about the service provider, the decision being based on the service information;

data entry information informing the user about utilizing a service offered by the service provider; and

contact information containing instructions for enabling the client device to communicate with the service provider.

Claim 32: (previously presented) The method of claim 29 wherein the advertisement is conveyed from the transmitter as a diffuse infrared signal.

Claim 33: (previously presented) The method of claim 32 wherein the diffuse infrared signal has a wavelength in the range of 850 nanometers to 1250 nanometers.

Claim 34: (previously presented) The method of claim 33 wherein the diffuse infrared signal is generated by modulating an electric light.

Claim 35: (previously presented) A method of utilizing executable code in a client device receiving an unsolicited, formatted advertisement from a transmitter located outside the client device, said method comprising the steps of:

receiving the unsolicited, formatted advertisement from an infrared communication signal conveyed from the transmitter, wherein the transmitter formatted the advertisement, and arriving at a

communication interface associated with the client device, the unsolicited, formatted advertisement containing at least a portion of a service offered by a service provider;

decoding, by the client device, the unsolicited, formatted advertisement to extract information contained therein;

relating, by the client device, the information to user-specific data in the client device; and

displaying, by the client device, the information related to the user-specific data to a user of the client device.

Claim 36: (previously presented) The method of claim 35 wherein said unsolicited, formatted advertisement is comprised of an XML element.

Claim 37: (previously presented) The method of claim 36 wherein the unsolicited, formatted advertisement further comprises:

service information enabling the user to make a decision about the service, the decision based on the service information;

data entry information informing the user about utilizing the service; and

contact information containing instructions enabling the client device to communicate with the service provider.

Claim 38: (previously presented) The method of claim 37 wherein the transmitter includes an emitter link layer.

Claim 39: (previously presented) The method of claim 38 wherein the client includes a client device link layer.

Claim 40: (previously presented) The method of claim 39 wherein the emitter link layer is compatible with the client device link layer.

Claim 41: (previously presented) The method of claim 40 wherein the information about the service is displayed to the user if the client device is running a plug-in cooperatively associated with the service.

Claim 42: (previously presented) The method of claim 41 wherein the plug-in further comprises information about a preference of the user.

Claim 43: (cancelled)

Claim 44: (cancelled)

Claim 45: (previously presented) The method of claim 19 wherein the unsolicited information is conveyed from the transmitter as a radio frequency (RF) signal.

Claim 46: (cancelled)

Claim 47: (previously presented) A method for determining a user response to predetermined information relevant to a client device at the location, said method comprising the steps of:

formatting, outside the client device, the predetermined information including:

service information indicating the purpose of the service;

data entry information indicating options based on the purpose; and

contact information enabling the client device to communicate with the service;

forming a signal containing the predetermined information;

propagating the signal from a transmitter to the client device within the location;

receiving the signal at the client device;

extracting the predetermined information; and

determining, by the client device, a user response to the predetermined information from user eye movement.

X. RELATED PROCEEDINGS APPENDIX

No related proceedings.

XI. EVIDENCE APPENDIX

Appellants herein present nine sheets of drawing which are referred to in the Appeal Brief:

1. Hendrey's FIG. 1, first cited against Appellant in the Office Action of November 17, 2005;
2. Weiss's FIG. 1, first cited against Appellant in the Office Action of November 17, 2005;
3. Weiss's FIG. 2, first cited against Appellant in the Office Action of November 17, 2005;
4. Appellant's FIG. 1A, filed with Appellant's patent application on August 15, 2001;
5. Appellant's FIG. 1B, filed with Appellant's patent application on August 15, 2001;
6. Appellant's FIG. 15, filed with Appellant's patent application on August 15, 2001;
7. Appellant's FIG. 17, filed with Appellant's patent application on August 15, 2001;
8. Appellant's FIG. 18, filed with Appellant's patent application on August 15, 2001; and
9. Appellant's FIG. 19, filed with Appellant's patent application on August 15, 2001.

Appellants herein include three attachments that are referenced in the Argument:

A. Alwan, Jim, *Eye Safety and Wireless Optical Networks (WONS)*, White Paper 802-0004-000, AirFiber, Inc., 2001, p. 8.
http://www.systemsupportsolutions.com/whitepapers/WP_laser_eye_safety.pdf.

B. Kahn et al., Introduction to *High-Speed Non-Directional Infrared Communication for Wireless Local-Area Networks*, Department of Electrical Engineering and Computer Sciences, University of California, Berkeley, CA 94720, http://iss.bu.edu/jbc/Publications/jbc-c2.pdf.

C. *RF Protocol Design and Reconfigurable Logic Implementation for Low Power Appellants,* Alvarez et al., Facultad de Informatica UPV/EHU, San Sebastian, Gipuzkoa, Spain, 2003.

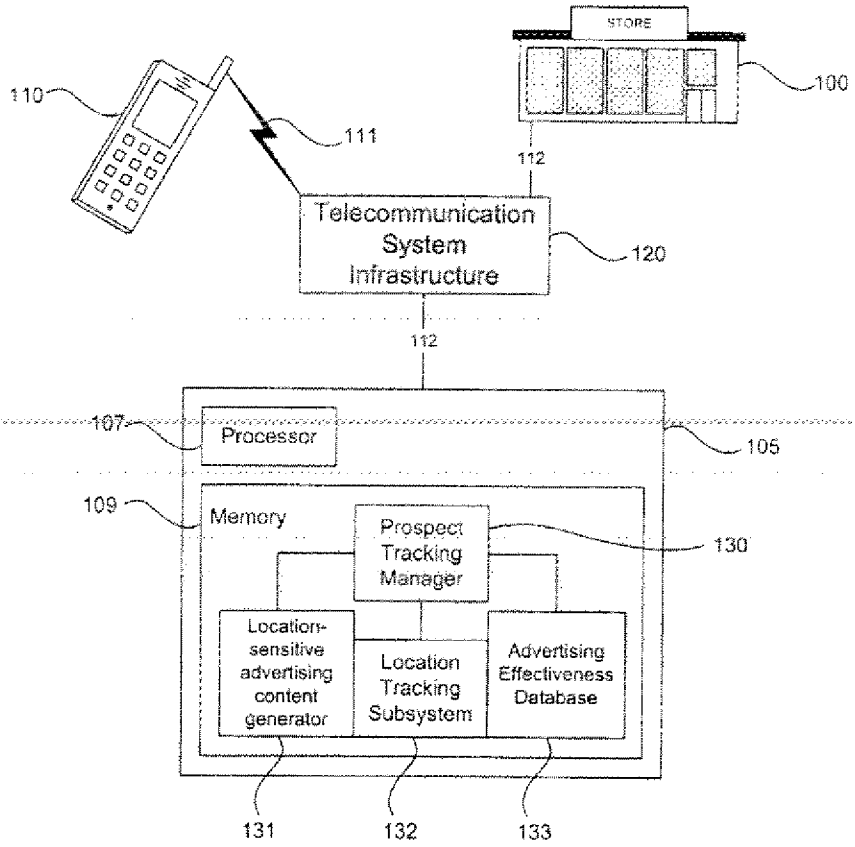
STORE
100
110
111
112
Telecommunication System Infrastructure
120
112
107
Processor
105
109
Memory
Prospect Tracking Manager
130
Location-sensitive advertising content generator
Location Tracking Subsystem
Advertising Effectiveness Database
131
132
133

FIG. 1

WEISS

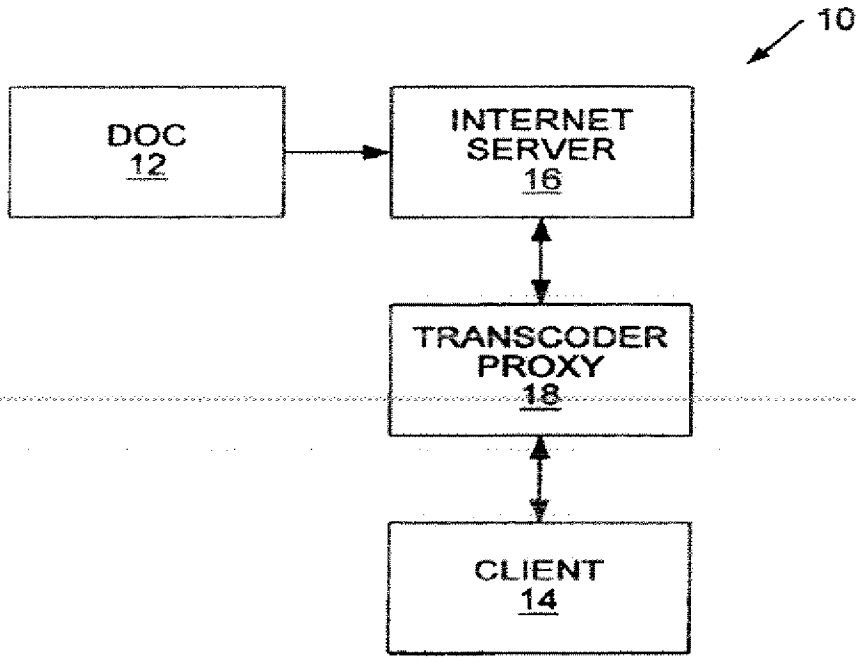

FIG. 1
(PRIOR ART)

WEISS

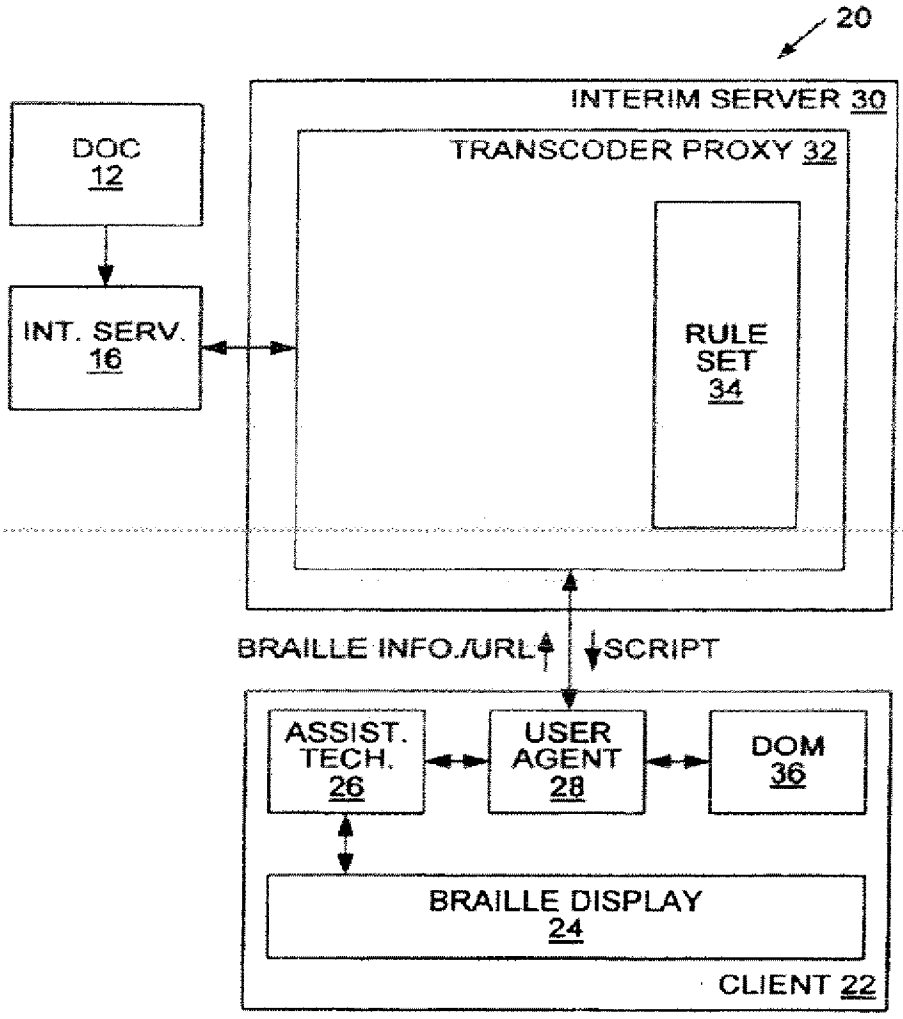
20
INTERIM SERVER 30
TRANSCODER PROXY 32
DOC 12
INT. SERV. 16
RULE SET 34
BRAILLE INFO./URL
SCRIPT
ASSIST. TECH. 26
USER AGENT 28
DOM 36
BRAILLE DISPLAY 24
CLIENT 22

FIG. 2

APPELLANTS

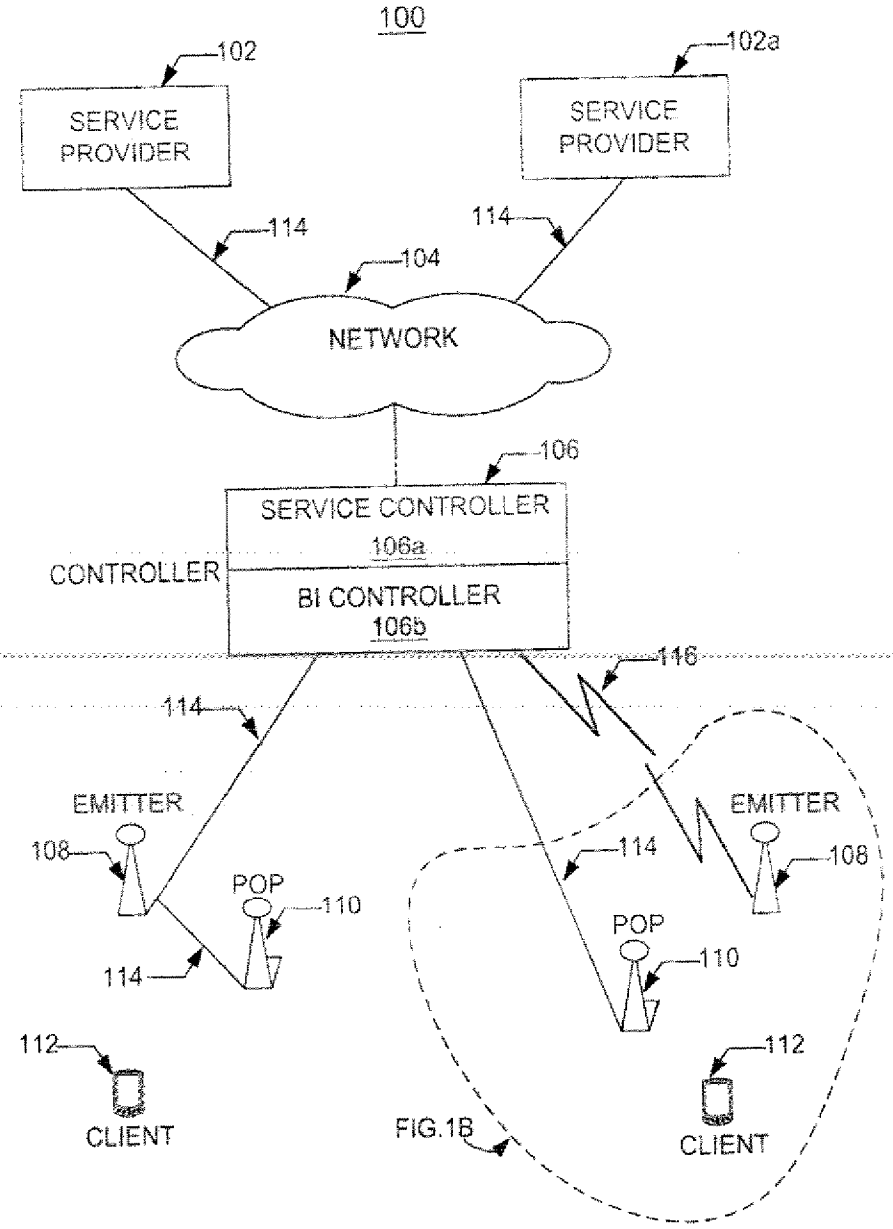

FIG. 1A

APPELLANTS

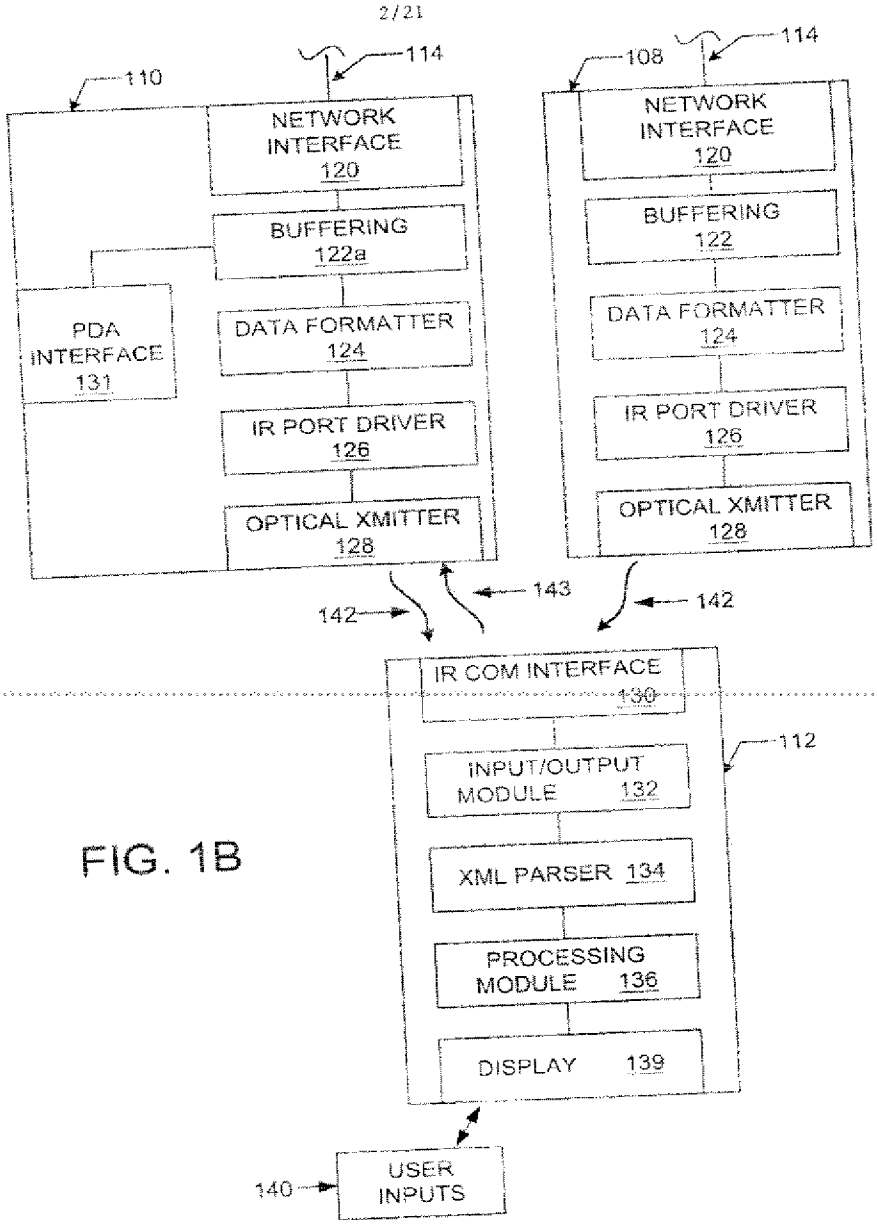

FIG. 1B

APPELLANTS

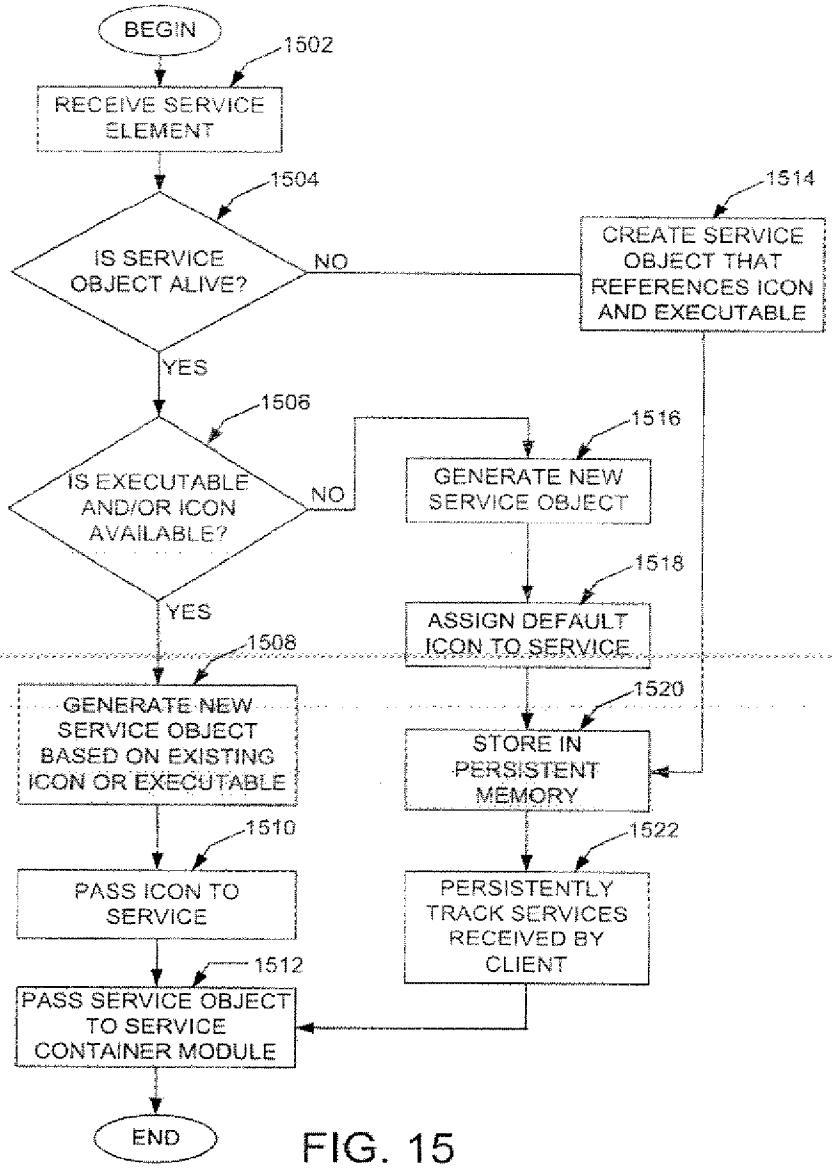

FIG. 15

APPELLANTS

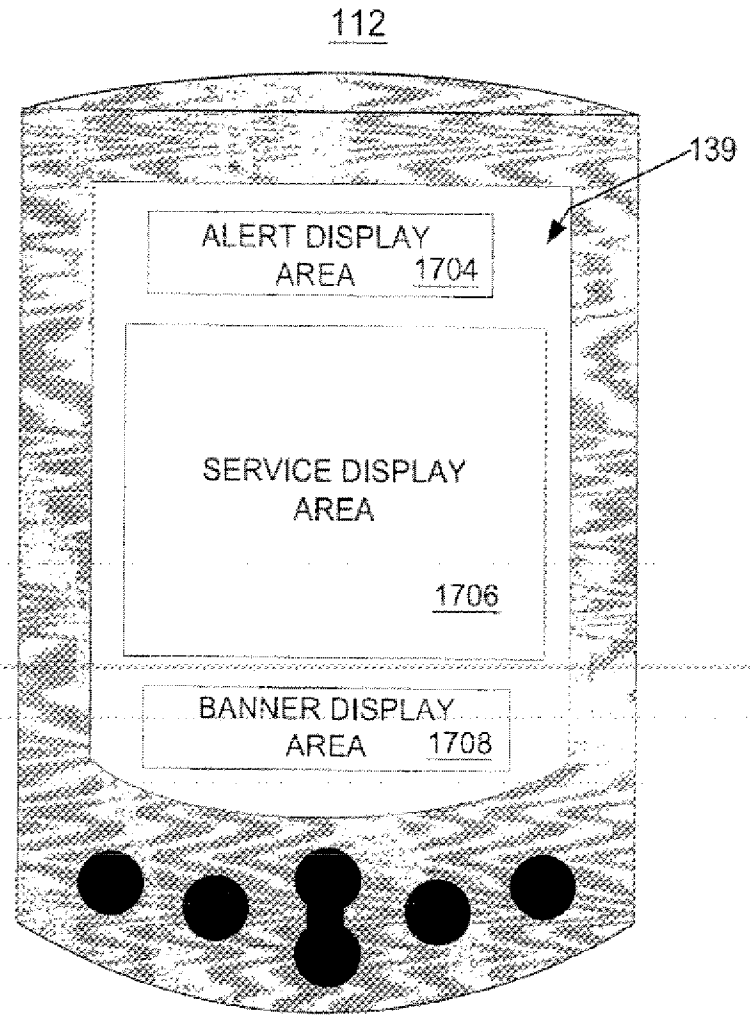

FIG. 17

APPELLANTS

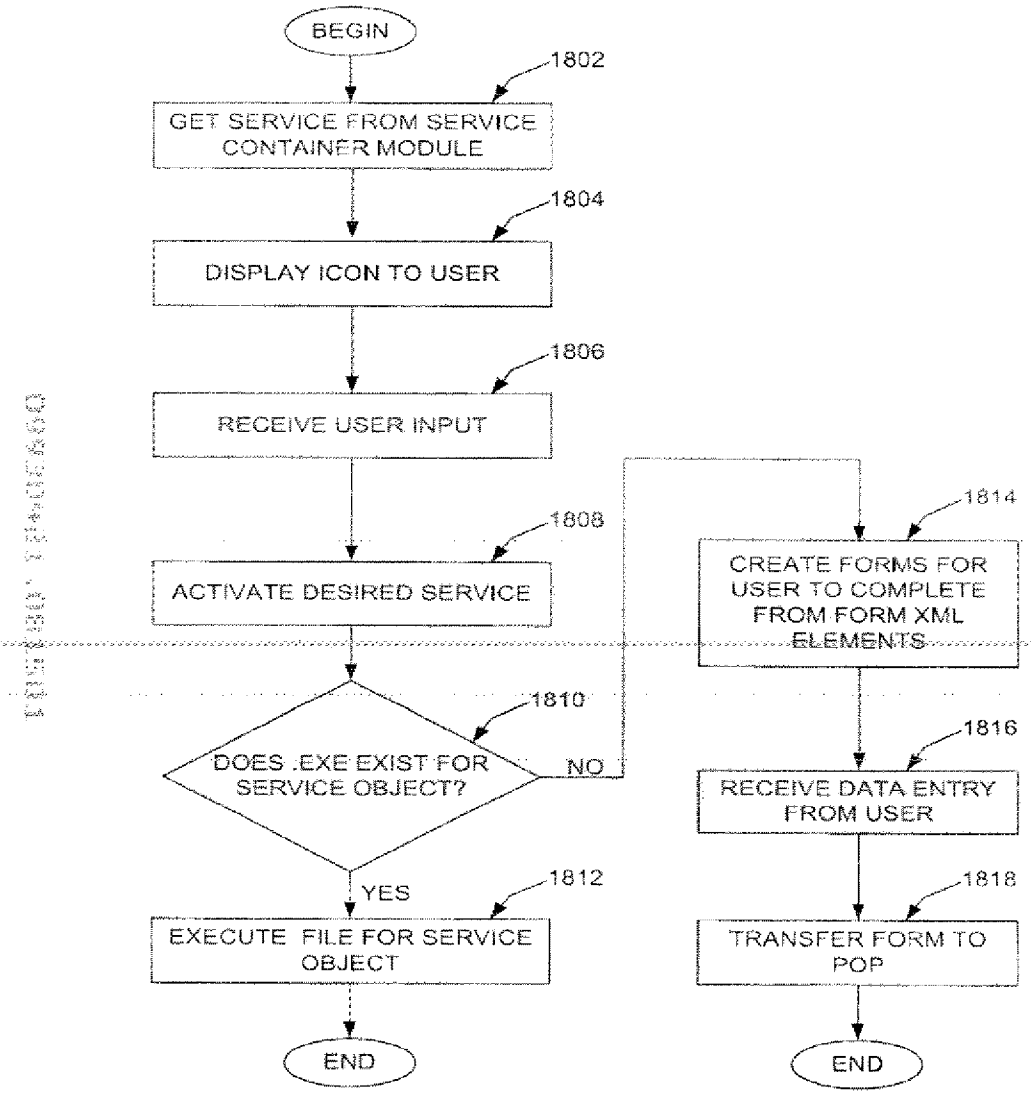

FIG. 18

APPELLANTS

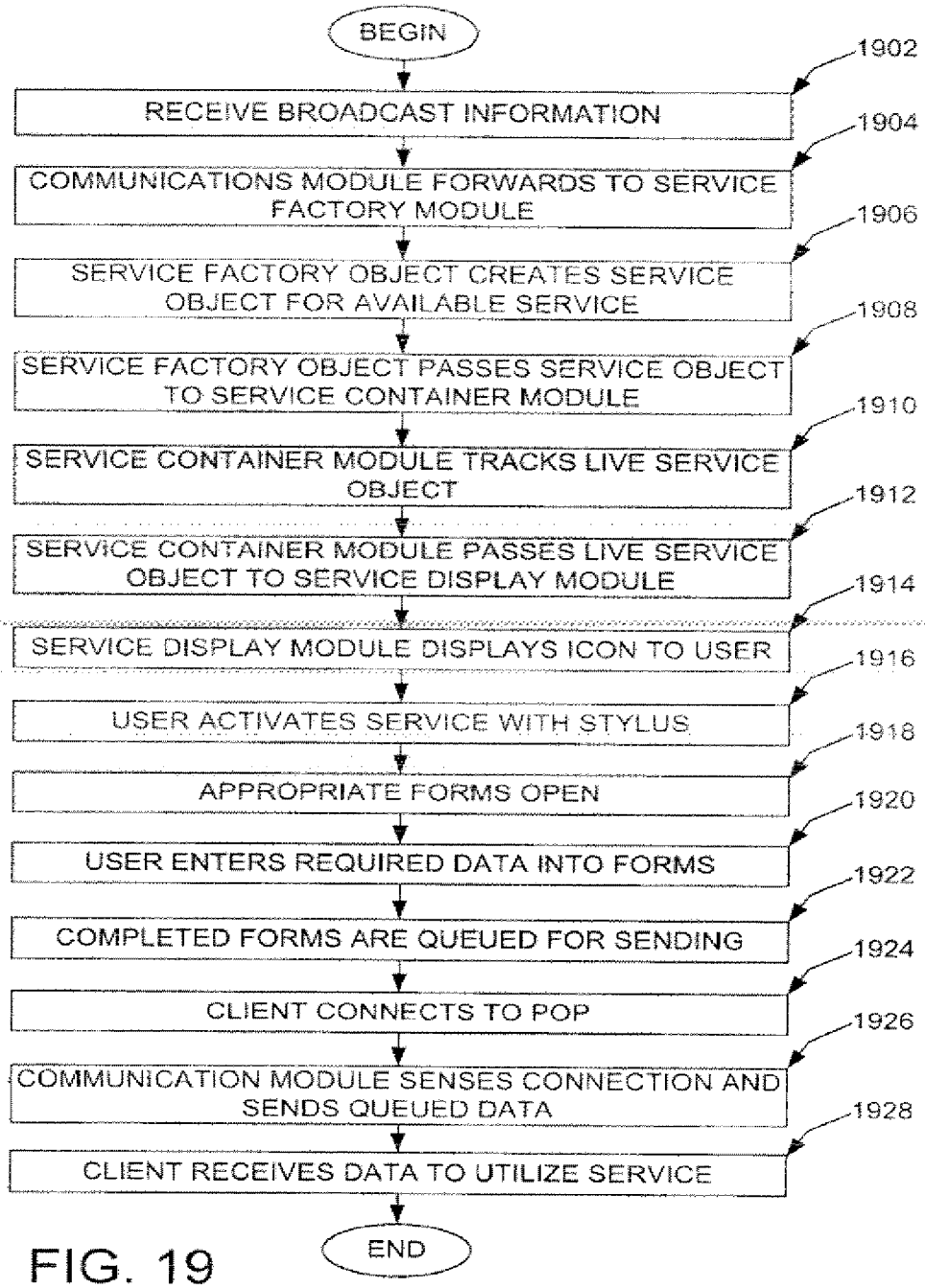

FIG. 19

High-Speed Non-Directional Infrared Communication for Wireless Local-Area Networks

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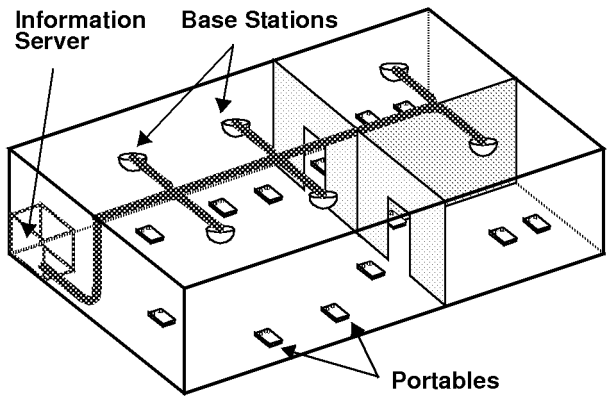
Abstract

Wide-area infrared beams can be used to establish high-speed digital links between portable terminals and a base station, allowing construction of in-building wireless local-area networks. We discuss key impairments to high-speed communication using non-directional infrared links: small received signal power in the face of potentially intense ambient infrared radiation, and intersymbol interference caused by multipath optical propagation. We discuss transmitter and receiver design strategies to achieve a high signal-to-noise ratio. We present experimental measurements of multipath dispersion, and we evaluate the performance of two communication techniques that attempt to counter multipath distortion: baseband on-off keying with adaptive decision-feedback equalization and multiple-subcarrier modulation.

1.0 Introduction

Non-directional infrared radiation [1-4] is an attractive transmission medium for wireless indoor access to local-area networks (see Fig. 1). The most important advantages offered by infrared over radio are the availability of a virtually unlimited, unregulated spectrum, and the fact that infrared radiation does not pass through walls or other opaque barriers. Single infrared links can operate with bit rates as high as 100 Mb/s. Since it is possible to operate at least one infrared link in every room of a building without interference, the potential capacity of an infrared-based network is extremely high.



ig. 1 A local-area network employing wireless infrared ccess.

Because of the availability of low-cost, high-power, GaAs-based laser diodes and large-area silicon photodiodes, the wavelength band near 800 nm is probably the best choice for diffuse infrared communications. Eye safety will require that the transmitted radiation be diffused and spread over an extended emitting aperture.

The propagation characteristics of non-directional infrared radiation are similar to those of radio, in that if one measured the received power vs. position using a detector much smaller than the wavelength, one would record substantial fluctuations of received power level, i.e., multipath fading. In practical infrared systems, however, the detector size is much larger than the wavelength, so that such power fluctuations are averaged out effectively. The existence of multiple propagation paths does lead to temporal dispersion [5, 6]. The channel temporal response is stationary for a fixed configuration of source, reflectors and receiver; changes in this response are observable only if the configuration is changed on a distance scale of at least $c\Delta t$, where c is the speed of light and Δt is the measurement temporal resolution.

2.0 Experimental Channel Characterization

We have experimentally characterized free-space infrared channels in a variety of indoor environments [6] using a swept-modulation-frequency technique. A vector network analyzer provides a swept-frequency sinusoid to modulate the intensity of a 100-mW, 810-nm laser diode. The transmitter employs a translucent diffuser, so that it radiates in a Lambertian intensity pattern.

Our receiver employs a 5 mm × 5 mm avalanche photodiode (having an acceptance half-angle of about 70°) coupled to a wideband transimpedance amplifier, and achieves a 3-dB bandwidth of 150 MHz. The receiver output is monitored by the network analyzer. All channel measurements are normalized to the response of a 1-m-long line-of-sight reference channel. Results are presented in terms of an equivalent electrical channel frequency response $H(f)$ and impulse response $h(t)$, since the entire optical link, from laser input to detector output, can be represented as an equivalent baseband electrical system. Normalization is chosen so that for a 1-W transmitter, the signal irradiance (measured in dBW/cm^2 into an acceptance half-angle of 70°) equals 0.5 [|H(0)| (in dB)].

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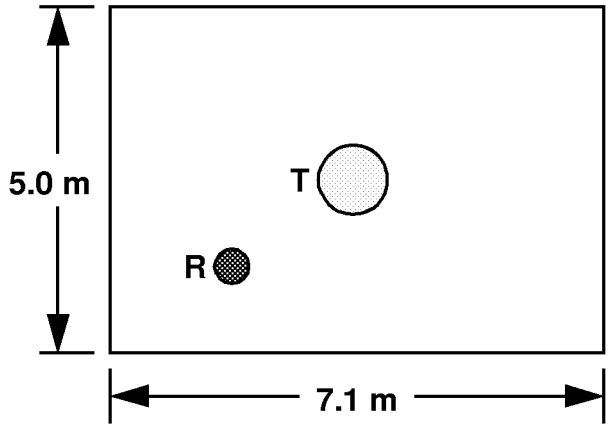


ig. 2 Top view of room in which channel measurements ere made. Walls and ceiling are painted plaster (diffuse eflectivity ~70%) and floor is grey carpet (diffuse reflectivity 10%). Ceiling height is 3.5 m. Receiver is placed 1 m above loor and pointed straight up. Source is either: (a) placed at eiling and pointed straight down, or (b) placed 1 m above floor nd pointed straight up.

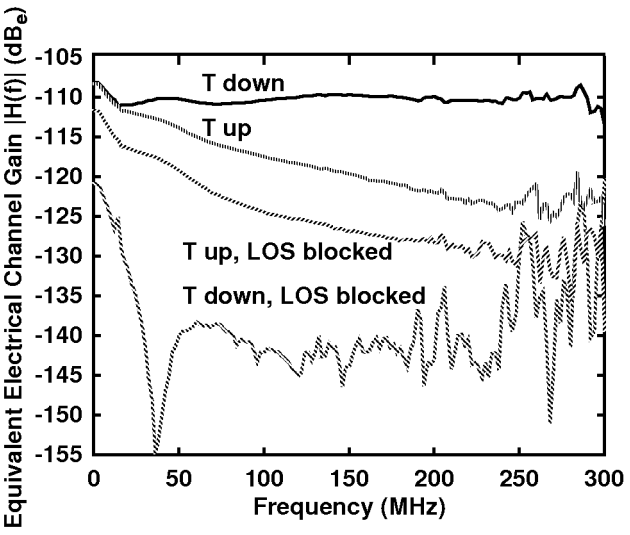
Measurements performed in a conference room having painted plaster walls (Fig. 2) are presented in Figs. 3 and 4. With the transmitter placed at ceiling height and pointed downward (T down), we obtain the widest channel bandwidth and an impulse response dominated by the line-of-sight component. With transmitter pointed downward, the resulting beam, since it emanates from a small area, is easily blocked by shadowing. When a hand is placed about 15 cm away from the receiver so as to block the line-of-sight path (T down, LOS blocked), received optical average power is reduced by 6.5 dB and the frequency response and impulse response are greatly degraded.

Alternatively, the transmitter may be placed at desk height and pointed upward to bounce off the ceiling; this results in a diffuse source (T up). Since the ceiling has a high diffusive reflectivity, this results in virtually no reduction of received optical average power as compared to the case labeled "T down". However, the high-frequency attenuation of the channel "T up" is much greater than that of "T down". The increased temporal dispersion is also evident in the impulse response, where a significant broadening of the first arriving component is observed. The practical advantages of this diffuse source become evident when a hand is placed 15 cm away from the receiver, along the line joining the receiver with the center of the illuminated ceiling spot (T up, LOS blocked). As compared to "T up", the results are a 2-dB reduction of received optical average power, and a moderate increase in high-frequency attenuation and impulse-response broadening. It should be noted that the channel "T up, LOS blocked" is greatly superior to "T down, LOS blocked" in all respects. Most applications of wireless infrared links will require robustness against shadowing, and our results clearly indicate the superiority of an extended, diffuse source in this regard.

3.0 Achieving a High Signal-to-Noise Ratio

Most applications of non-directional infrared links will require operation in the face of potentially strong ambient infrared radiation. Bright daytime skylight, for example, yields a background irradiance per unit filter bandwidth as high as 5.8 $\mu W/cm^2$-nm in the wavelength range near 800 nm [1]. Unfortunately, non-directional infrared channels generally have a high path loss. For example, in Fig. 3, under conditions labeled "T up, LOS blocked", the d.c. gain of -111.5 dB_e implies that with a 1-W source, the received signal irradiance would be 2.7 $\mu W/cm^2$. Clearly, careful design is required for a receiver to achieve a high signal-to-noise ratio (SNR) in the face of ambient skylight. In the presence of intense background light, the SNR of a well-designed receiver is limited by shot noise induced by the background light [7]. At lower levels of illumination, the SNR will increase, and will be limited instead by preamplifier circuit noise.

The electrical SNR of a shot-noise limited receiver is directly proportional to detector area A_{det}; while the detected electrical signal power scales as A_{det}^2, the detected shot-noise power is proportional to A_{det}. A large detector can be costly, and it increases receiver front-end capacitance, potentially limiting receiver electrical bandwidth. It is possible to reduce the required physical detector size by placing a high-refractive-index hemispherical concentrator in front of the detector [3]. For detector radius r, concentrator radius R and refractive index n, if $R > n^2 r$, then the optical gain is $G \approx n^2$, largely independent of angle of incidence[4]. Careful attention must be paid to anti-reflection coatings and index matching to min-



ig. 3 Magnitude response |H(f)| of equivalent electrical hannel for the configuration depicted in Fig. 2. H(f) is scaled so hat, for a 1 W transmitter, the received irradiance (in dBW/cm^2) quals 0.5 [|H(0)| (in dB)].

imize reflection-induced losses at the lens-to-detector interface.

To achieve a sufficient SNR in high-bit rate applications, it is helpful to use a narrow-optical-bandwidth laser-diode transmitter, and to restrict detected ambient light using a narrow-band optical filter. In practice, such a filter is normally constructed using multiple-layer dielectric coatings [8]. Unfortunately, the bandpass wavelength of such a filter shifts as one varies the angle of incidence with respect to the filter surface, as illustrated in Fig. 5. Thus, if one places a flat filter between the hemispherical concentrator and the detector, a narrow passband implies a restricted receiver field of view. This problem can be solved [2] if the filter is deposited instead on the front face of the hemisphere (Fig. 6). All rays that pass through the filter and lens, eventually striking the detector, will strike the filter at an angle between 0° and 30° with respect to the filter surface, as shown by ray-tracing calculations [4]. This allows the filter bandwidth to be narrowed considerably without restricting receiver field of view.

We have performed a joint optimization of transmitter radiation pattern and receiver optical design [4]. For simplicity, we consider a 100-Mb/s, baseband on-off-keyed, line-of-sight link (analogous to Figs. 3 and 4, "T down") in a 5 m × 5 m room. We consider link performance along the "cell boundary", a locus of points from the center of the room at lap height, to the corner of the room at neck height. We assume a receiver configuration as shown in Fig. 6, with a lens having refractive index n = 1.8 (5.1 dB optical gain). As an alternative, we consider a receiver using a flat filter placed between the hemisphere and detector. Anti-reflection coatings are designed to minimize the reflection losses at the worst-case position along the cell boundary.

It is easy to show that the optimal transmitter radiation pattern, which maximizes the worst-case SNR within

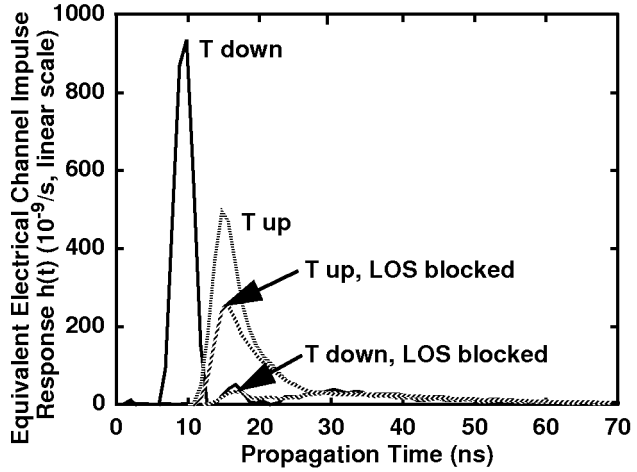


Fig. 4 Impulse response of equivalent electrical channel for the configuration depicted in Fig. 2, obtained by inverse Fourier-transformation of H(f) using a 300-MHz Hamming window.

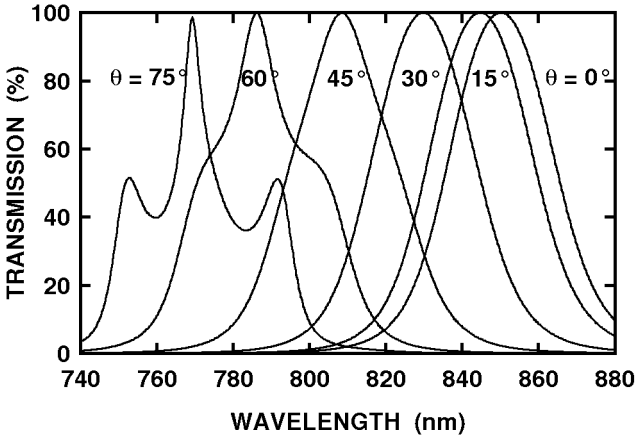


Fig. 5 Wavelength-dependent transmission for various angles of incidence with respect to surface normal θ, for a 25-layer, three-cavity thin-film optical filter. At θ = 0, this filter is described by $\Delta\lambda$ = 31 nm and λ_{max} = 850 nm. Transmission is averaged over two orthogonal polarizations.

the cell, is such that the received signal power is identical at every point on the cell boundary [4]. For a given filter bandwidth $\Delta\lambda$ and orientation Θ (the angle with respect to surface normal of the filter at which the wavelength of peak transmission coincides with the signal wavelength), and assuming an optimal radiation pattern, the SNR at every point on the cell boundary is identical. The optimal values $\Delta\lambda_{opt}$ and Θ_{opt} can be found by maximizing this "boundary" SNR using a two-dimensional grid search.

Optimized link parameters are presented in Table 1. Assuming a hemispherical filter as shown in Fig. 6, optimum filter bandwidth is $\Delta\lambda_{opt}$ = 11.6 nm, while optimum filter orientation is Θ_{opt} = 15.2°. Assuming a detector area of A_{det} = 1 cm^2, the SNR along the cell boundary is 28.5 dB. If instead we require a SNR of only 21.6 dB (sufficient to achieve 10^{-9} bit-error rate, assuming no degradations other than noise), the shot-noise-limited detector area can be reduced to only 0.2 cm ^{2}. If one assumes a flat filter (see Table 1), then one must employ a much wider filter bandwidth to prevent signal loss at locations near the corner of the room. For a given detector area, the flat-filter SNR is lower than the hemispherical-filter SNR by 6.8 dB.

Considering noise originating in the receiver preamplifier, analysis has shown that using transistors having sufficiently high transconductance g_m, it is possible to achieve substantially shot-noise-limited operation [4, 7].

4.0 Signaling Techniques for the Multipath Channel

As a signaling technique for wireless infrared links, baseband on-off keying (OOK) has several potential advantages: high electrical bandwidth efficiency (important in view of large detector capacitance), high optical power efficiency, and easy compatibility with baseband

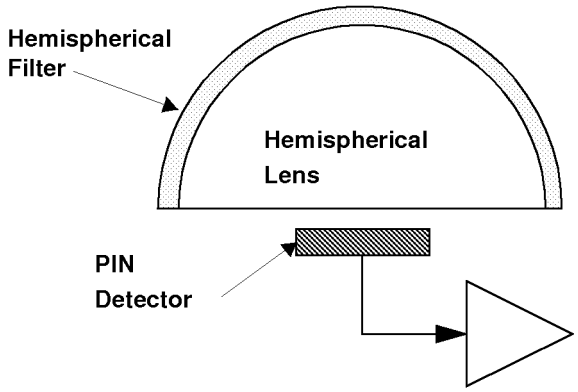


Fig. 6 Configuration of receiver optics, showing high-index hemispherical concentrator, hemispherical thin-film optical filter, and p-i-n photodiode. Not shown are anti-reflection coatings and index-matching materials.

digital circuitry. The impulse response of a typical non-directional infrared channel (Fig. 4) exhibits a delay spread of the order of 50 ns, producing inter-symbol interference (ISI) that potentially impairs baseband OOK links at bit rates above 10 Mb/s [5]. For non-directional channels similar to those represented in Figs. 3 and 4, we have evaluated the performance of a 100-Mb/s baseband OOK link, and the multipath-induced optical average power penalties are tabulated in Table 2. These significant penalties, particularly for the channel "T up, LOS blocked", are clearly unacceptable in most applications. Fortunately, an adaptive decision-feedback equalizer (DFE) can mitigate effectively multipath-induced ISI [9]. For the same channels, an unconstrained-complexity, minimum-mean-squared-error DFE reduces the ISI penalties to less than 3 dB (Table 2). Considering channels similar to Fig. 4 "T down", simulations [9] have shown that nearly the full performance improvement can be achieved using a DFE that has three half-baud-spaced forward taps and five baud-spaced reverse taps, and that is adapted according to the least-mean-squares algorithm.

If a single high-speed wireless infrared link is used to convey multiplexed lower-bit-rate data to several users, OOK modulation presents a drawback: it requires that each receiver detect the aggregate high-speed bit stream and perform digital demultiplexing to obtain the desired data. This drawback of OOK is overcome by using an alternative modulation technique, multiple-subcarrier modulation.

In multiple-subcarrier modulation, as illustrated in Fig. 7, various independent bit streams $d_i(t)$ are modulated onto r.f. carriers at several frequencies (say of the order of 10 to 100 MHz). The modulated subcarriers $u_i(t)$ are summed together to form the frequency-division multiplexed signal $X(t)$, and $X(t)$ is used to modulate the intensity of a laser transmitter. If the $u_i(t)$ are conventional PAM or FSK signals, then a d.c. bias must be added to the laser modulation signal, since the optical intensity cannot be made negative. Since a photodetector responds only to the intensity of the incident light, the detector output $Y(t)$ is simply a replica of $X(t)$, scaled according to the channel frequency response $H(f)$, and with noise added. One can recover the individual bit streams $d_i(t)$ using multiple r.f. bandpass demodulators. This allows each receiver to process only the data intended for it.

When multipath dispersion is present, then in the detector output $Y(t)$, each subcarrier $u_i(t)$ will be attenuated differently, according to the channel magnitude response at frequencies near the subcarrier frequency f_i. Assuming that the subcarrier signaling rate is of the order of 10 Mbaud or lower, the multipath attenuation will be approximately constant across the relatively narrow frequency band it occupies, so that each subcarrier will suffer little multipath distortion.

We have analyzed the performance of a link that uses five, 10-Mbaud QPSK subcarriers at 10, 30, 50, 70 and 90 MHz to achieve an aggregate bit rate of 100 Mb/s (see Table 2). Over a flat channel, there is an optical average power penalty of 4.7 dB with respect to baseband OOK, which arises from the need to transmit a d.c. bias. For multipath channels similar to those represented in Figs. 3 and 4, we adjust the relative amplitude of each subcarrier $u_i(t)$ to compensate for the frequency-dependent attenuation near f_i, achieving the same SNR in each subcarrier (multipath-induced ISI and interference between I and Q channels induce little degradation). As shown in Table 2, on the realistic channel "T up, LOS blocked" the five-QPSK sub-

Table 1. Parameters of optimized 100-Mb/s baseband on-off-keyed line-of-sight link assuming: 1-W, 810-nm source optimally distributed throughout a 5 m × 5 m room, hemispherical concentrator having refractive index of 1.8 (providing an optical gain of 5.1 dB), background irradiance of 5.8 μW/cm^2-nm, detector responsivity of 0.53 A/W, shot-noise-limited SNR, optimized anti-reflection coatings, and filter similar to that depicted in Fig. 6. Optimized parameters include: $\Delta\lambda_{opt}$ (3-dB width of filter), Θ_{opt} (angle with respect to surface normal of filter at which wavelength of peak transmission coincides with signal wavelength), P_{min} (signal irradiance at worst-case location), SNR_{min} (SNR for a 1 cm^2 detector at locations along cell boundary), and $A_{det,SNL}$ (detector area required to achieve a SNR of 21.6 dB at locations along cell boundary).

Parameter	Planar	Hemisph.	Units
$\Delta\lambda_{opt}$	71.7	11.6	nm
Θ_{opt}	47.2°	15.2°	degrees
P_{min}	2.6	2.3	μW/cm^2
SNR_{min}	21.7	28.5	dB
$A_{det,SNL}$	0.97	0.20	cm^2

Table 2. Calculated optical average-power penalties for a 100-Mb/s link using channels similar to those depicted in Figs. 3 and 4. Baseband OOK system uses rectangular transmitted pulses and a rectangular-impulse-response receiver filter. Subcarrier system employs 10-Mbaud QPSK subcarriers at 10, 30, 50, 70 and 90 MHz with rectangular transmitted pulses and rectangular-impulse-response receiver filters. For each channel response, subcarrier amplitudes are adjusted to compensate for frequency-dependent attenuation, achieving same SNR in each channel. White noise is assumed.

Channel	Baseband OOK, no DFE	Baseband OOK, MSE DFE	Normal QPSK SCM	Clipped QPSK SCM
No multipath	0.0 dB	0.0 dB	4.7 dB	3.0 dB
T down	6.6	2.3	8.2	6.3
T up	6.4	2.3	9.5	7.4
T up, LOS blocked	10.2	2.9	11.5	9.2

carrier system performs (11.5 dB - 2.9 dB) = 8.6 dB worse than the baseband OOK with DFE.

The performance of a multiple-QPSK-subcarrier system can be improved through the use of clipped QPSK subcarriers. In the system of Fig. 7, each of the subcarriers $u_i(t)$ is half-wave rectified to make it non-negative, obviating the need for the d.c. bias (except as required to reach laser threshold). In principle, clipped subcarriers can be demodulated using a normal QPSK demodulator.

5.0 Acknowledgments

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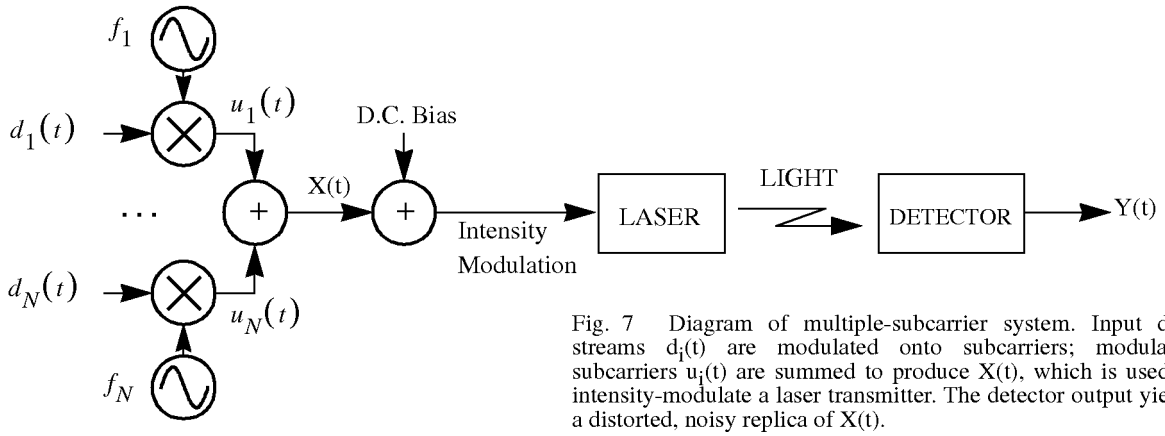

Fig. 7 Diagram of multiple-subcarrier system. Input data streams $d_i(t)$ are modulated onto subcarriers; modulated subcarriers $u_i(t)$ are summed to produce X(t), which is used to intensity-modulate a laser transmitter. The detector output yields a distorted, noisy replica of X(t).

RF PROTOCOL DESIGN AND RECONFIGURABLE LOGIC IMPLEMENTATION FOR LOW POWER APPLICATIONS

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Abstract

In this paper we present the design of a protocol for a wireless communication system. This protocol is implemented in reconfigurable logic devices and has a modular structure that admits a fast and easy adaptation to different commercial transceivers. Applying this protocol it is possible to transmit the information using different free frequency bands depending on the speed, distance an consumption requirements of the application in use. This protocol follows the Master-Slave model according with the retransmission policy of a Stop and Wait protocol. It has been implemented in reconfigurable logic devices and this implementations have been tested with several wireless transceivers in the 434 MHz, 868 MHz and 2.4 GHz frequency bands. It has also been developed a test system to estimate which are the best system parameters (speed, distance, data size, etc) for each application. The modular design of this protocol has allowed the evaluation of different characteristics as data codification methods and different retransmission policies.
This protocol has been developed for a special wireless communication system based on an autonomous low power sensor net. As it has specific restrictions of power consumption and data speed transmission it has been necessary to develop a proprietary protocol and a power control strategy to reduce the power consumption of the programmable logic devices. With this protocol it is possible real time wireless reconfiguration of FPGAs, that is a very interesting option for example to update the functionality of distributed autonomous elements as sensors.

Keywords
Wireless protocol, master/slave, stop and wait, low power application, reconfigurable device implementation.

1 Introduction

The wireless communications development has made them useful in almost every application. The DCI group of the Computer Engineering Faculty of the Basque Country UPV/EHU has a great experience in the development of projects based on electronic technologies for different applications. In these ones often appears the need of a bidirectional wireless communication between a host and several isolated elements.
The implementation of the system on reconfigurable logic devices based on a modular structure, allows an easy adaptation to different RF commercial transceivers and the use of different free RF bands depending on the data transmission speed, distance and consumption requirements.

2 General description of the wireless system.

A Master/Slave model with a star topology has been chosen for the protocol implementation. The system allows communicating several isolated elements (Slaves) with a central module (Master). Is the Master the one who holds the communication control weight. With this model the possibility of collisions during communication is avoided and the master controls the access to the line.

At application level, the master is connected to a host (PC or PDA) using a communication line (RS232 or USB). The host has two functions one is the master configuration with the slave list and the other the control of each bidirectional slave communication.

The Master module asks to each slave (in a circular turn). It sends a data packet to a slave indicating which is its communication turn. The slave answers with one or several packets depending on the amount of information to transmit. The Master can also send data to a slave during the communication.
The developed protocol is an ad-hoc protocol whose protocol stack is similar to the one of a standard protocol [1]. It has been structured on three levels: Physical layer, medium access control (MAC) and logical link control (LLC). The last two ones are data link layer sub layers. At fig. 1. it is possible to see each level frame format. Due to the applications for which this protocol has been developed the high levels have not been implemented.
The Physical and MAC layers of Master and Slave are exactly the same but LLC layer is specific for each one. Some commercial transceivers include the Physical and MAC layers (nRF2401 [2]). In those cases the protocol is easier and only includes the LLC layer. Other transceivers [3],[4],[5] y [6] need all the protocol layers.
The communication model used is the STOP&WAIT model, but with certain characteristics that allows a future sliding window model implementation.
At the following chapters each protocol level will be detailed.

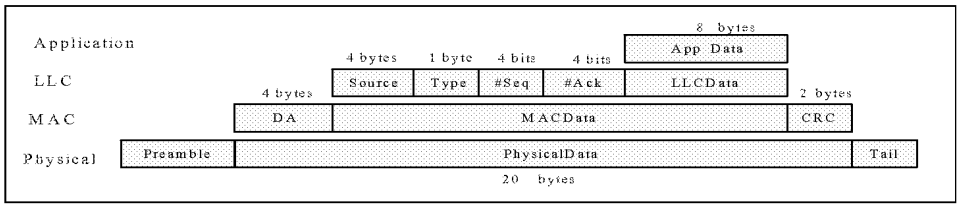


Fig. 1. Protocol stack data frame format.

2.1 Physical layer

As it was said before, this protocol has been developed with the aim to work with different RF commercial transceivers. That's why a transceiver independent Physical layer has been implemented. The used transceivers have a similar interface. All of them use RX and TX signals for data transmission and reception, TX_Enable and/or RX_Enable mode control and a carrier detect signal CD.
The Physical layer function is sending a frame at MAC level from the emitter to the receiver. As the used transceivers (Nordic nRF401 and Aurel) use FSK modulation, it is necessary to use certain data codification with the aim of guarantee data logic level periodical transition. At this implementation Manchester codification is used. With this codification each bit of data is codified in two bits (Fig.2).

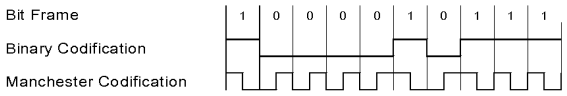
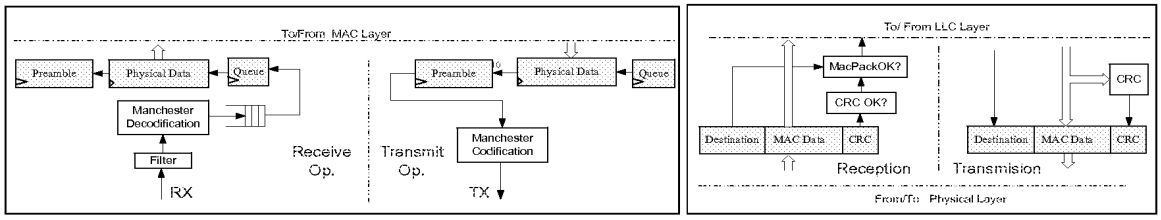


Fig. 2. Manchester Codification.

The Physical layer schema is shown at fig. 3.a. The emitter has a FIFO queue where a frame at MAC level is kept ready for transmission. A header and a tail are added to this data and then all is codified with Manchester codification and send to the transceiver (TX signal).
At reception the signal is filtered to reduce RX signal noise, the filtered data is then decodified and kept at the frame. When this frame format is correct (Header + Data + tail) it is send to MAC layer for validation. The header will be dependent on the codification used, its function is indicate the beginning of a data packet and manage correct synchronization.
As Manchester codification doubles the data amount and consequently reduces the data ratio, other codifications like data scrambling are being treated with the aim to improve the transmission efficiency. But is important to say that Manchester codification improves the transceiver sensibility.

2.2 Medium Access Control (MAC)

In a data transfer protocol over the Physical layer we can find the data link layer. This layer is divided in two sub layers, one of them is the logical link control sub layer and the other is the Medium access control sub layer. The last ones function is check that the data received are correct, without errors and with the correct emitter or receiver identifier. For the error detection a 16 bit CRC-CCIT with $P(X)=X^{16}+X^{12}+X^5+1$ as polynomial generator has been used. Frame validation consists on a CRC and identifier check, if both are correct the frame is considered as a valid frame and send to the LLC sub layer.



(a) Physical layer. **(b)** MAC layer.

Fig. 3. Functional blocks of Physical and MAC layers.

A MAC frame emission consist on build the frame with a destination identifier, data and a CRC frame of destination identifier and data and then this new frame is sent to the lower layer (Physical layer) (Fig. 3.b).

2.3 Logical Link Control (LLC)

This sub layer objective is to guarantee the correct data transmission between emitter and receiver, that is, the receiver module must send once in the correct order and without errors a data packet to the higher level (the application level in our system).

This protocol implements a half duplex communication where the master module controls the communication and gives permission to each slave to transmit, this way collisions are avoided.

This protocol uses a stop and wait retransmission strategy. Once the emitter sends a data frame, it is necessary to receive an acknowledge signal (ACK) to send a new frame. If no signal is received after a time-out the same frame is resend.
The Master has got a list of slaves for communication. The application layer sends this list to the LLC layer through an interface
To establish communication, the Master asks for information to each one of the slaves in a circular turn. The master sends a frame with or without data to a slave and gives to it permission to transmit. Then the slave can use the communication line and send the requested information. At fig. 4 the Master module automata is shown and at fig. 5 its block diagram.

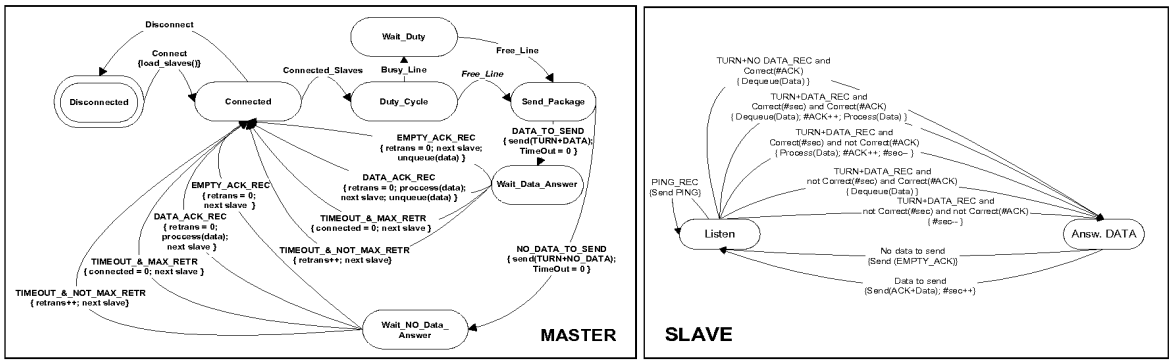


Fig. 4. LLC level master and slave automata

Due to European legislation for radio frequency systems [7][8][9] a transmission duty-cycle control has been added.

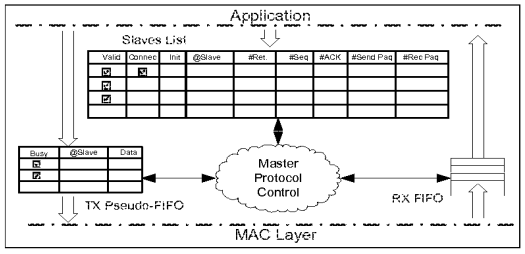


Fig. 5. . LLC level Masters module structure.

As the communication is controlled by the Master, the algorithm of the slave is much more simple. It just waits for the master request an when it happens sends the data following the stop and wait protocol. Fig. 4. represents the slave module automata

3 Implementation and results.

The design of the Master and Slave modules has been done using VHDL hardware description language and rapid prototyping platforms based on reconfigurable logic devices. At the beginning we used an evaluation platform Altera (APEXpert) and later we developed our own platforms based on logic reconfigurable devices like Altera APEX 20KE, Cyclone C3 and C6. We have used Quartus II as software tools for design and synthesis, ModelSim for simulation and SignalTap for validation. Table 1 shows information about hardware occupation for master and slave implementation. For the transceiver nRF401 the design includes the Physical layer and for the nRF2401 and the nRF905 don't.

	nrf 401						nrf 2401						nrf 905					
	Master			Slave			Master			Slave			Master			Slave		
	Logic Cells	Regs.	Memory Bits	Logic Cells	Regs.	Memory Bits	Logic Cells	Regs.	Memory Bits	Logic Cells	Regs.	Memory Bits	Logic Cells	Regs.	Memory Bits	Logic Cells	Regs.	Memory Bits
Protocol	2685	1316	6944	956	454	2816	2462	1337	6688	760	388	2560	2391	1312	6698	595	371	2560
LLC Level	1921	981	6688	272	122	2560	1649	1023	6688	238	106	2560	1791	1025	6688	180	132	2560
MAC Level	322	59	0	271	59	0	---	---	---	---	---	---	---	---	---	---	---	---
Physical Level	442	276	256	413	233	256	---	---	---	---	---	---	---	---	---	---	---	---
RF Interface	---	---	---	---	---	---	613	314	0	522	285	0	600	287	0	415	239	0

Table. 1. Hardware Occupation

Whether most transceiver manufactures give the maximum distance of transmission, in practice this distance is strongly dependent of factors like noise, transmission speed and data size. Then appears the need of test, which is the optimum configuration to obtain the best compromise between speed, data size and distance for each transceiver. With this aim we have developed a test bench using the SignalTap tool. With this test bench the number of correct transmissions between master and slave for different distances and speeds are counted, Master sends 1000 data packets to Slave and this resends them to Master. Some of the obtained result can be seen at Fig. 6.

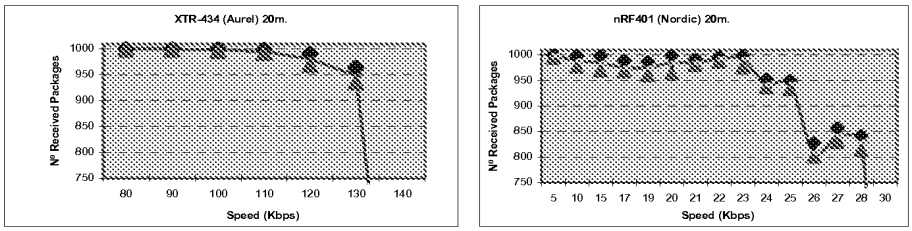


Fig. 6. XTR-434 and nRF401 modules test Results for a distance of 20m.

As it was mentioned this protocol has been specifically developed for a special wireless communication system based on an autonomous low power sensor net. This application requires operating for years on the same battery and for this reason every micro amp must be carefully scrutinized. With this aim the active duty cycle of the slaves has been drastically reduced. Each slave is activated periodically (T= f. e. one second) during a certain amount of time (activation time, f. e. 8ms) in a low power consumption mode

(10μA). If a Slave receives an activation request from the Master, then the full functionality of the Slave is activated. All this parameters are configurable depending on the application. With this philosophy the Master must request a Slave almost over T continuously to ensure the Slave activation. A good power supply is also very important. For the slaves we have used a 3,6 v 2,2Ah lithium battery. This kind of batteries offer a flat discharge profile, allowing virtually all of the batteries capacity to be used with almost constant output of 3,6V. The fig. 7 show a supply control example.

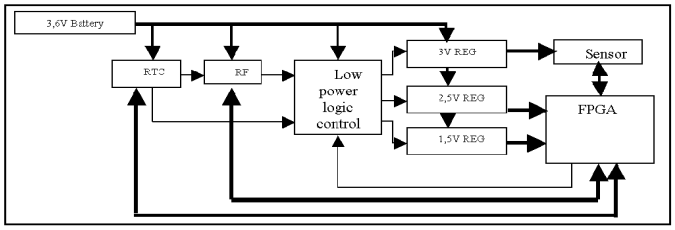


Fig. 7. Supply control example.

Several implementations of this system prototypes for XTR-434, RTX-RTLP434 y RTF-Data-SAW the AUREL modules and nRF401 and nRF2401 Nordic modules are shown at fig.8.

(a) Master XTR-434, (b) Master nRF401 (c)Slave nRF401

Fig. 8. Some prototypes pictures.

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